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Sport Fishery Abstracts

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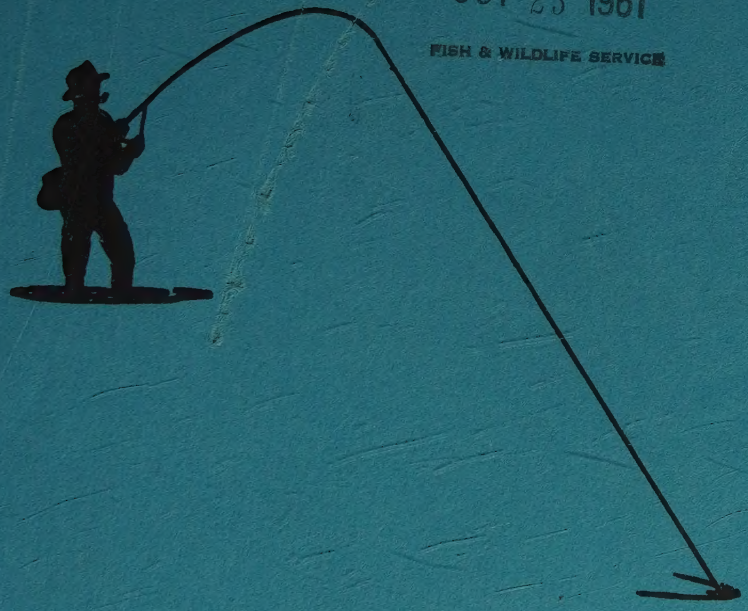

Vol. 6 No. 2
Abstracts 4027-4231
April 1961

DEPARTMENT OF THE INTERIOR
Stewart L. Udall, *Secretary*

U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE
Daniel H. Janzen, *Director*

The printing of this publication
was approved by the Director of
the Bureau of the Budget
January 4, 1961

Washington 25, D. C.

Sport Fishery Abstracts

An abstracting service for fishery research and management

Vol. 6, No. 2 Abstracts 4027- 4231 April 1961

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers is issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor
Geneva T. Thompson, Asst. Editor

4027. Oven, L. S. 1959. ABOUT THE DRIFTING APPROACH OF FINGERLING BLUEFISH - POMATOMUS SALTATRIX L. TO THE SHORES OF THE BLACK SEA IN THE REGION OF THE KARADAG (1947-1954). Works of the Karadag Biological Station, Academy of Sciences of Ukraine, U. S. S. R., Issue 14, 1947: 155-157; Maryland Department of Research and Education, Chesapeake Biological Laboratory, Ref. No. 59-27. (English translation from Russian)

Fingerling bluefish, Pomatomus saltatrix Linnaeus, ranging in length from 27 to 198 mm, drift in late summer to areas from 100 to 200 meters off the shore zone of the Black Sea, U. S. S. R. They arrive in the vicinity of the Karadag Biological Station in August when the sea water temperatures range from 18.0 to 24.5°C. and move offshore in October and November when the temperatures decline to the range of 13.0 to 15.0°C. The numbers that drift shoreward fluctuate from one year to the next, based on catches by a small-meshed drag-net. Stomach content studies of a small sample indicate that fingerlings over 80 mm feed largely on fish. (R. J. M.)

4028. Paloumpis, Andreas A., and William C. Starrett. 1960. AN ECOLOGICAL STUDY OF BENTHIC ORGANISMS IN THREE ILLINOIS RIVER FLOOD PLAIN LAKES. The American Midland Naturalist, Vol. 64, No. 2, pp. 406-435.

This investigation was conducted to show the effects that various types of pollutants have had upon the bottom fauna organisms in three Illinois River flood plain lakes. The lakes studied were in the vicinity of Havana, Illinois. Between 1952 and 1958, 363 bottom samples were taken with a 6 x 6-inch Ekman dredge. Results of chemical analyses indicated that all three lakes were rich in nutrients.

The annual standing crop of benthic organisms varied considerably in the three lakes. The average standing crop per square foot was: 495 organisms and 0.90 grams in Lake Matanzas; 1,108 organisms and 4.44 grams in Middle Quiver Lake; and 886 organisms and 1.50 grams in Lake Chautauqua.

Dipterous larvae were never abundant in the collections from Quiver Lake; however, they formed an important part of the benthic collections from Lake Chautauqua and Lake Matanzas. Fertilizing materials deposited by migratory waterfowl together with the scarcity of snails were considered as factors contributing to the development of large standing crops of dipterous larvae in Lake Chautauqua.

On the basis of numbers, Oligochaeta comprised over 60 per cent of the bottom fauna from all three lakes.

Hexagenia limbata nymphs represented 75.4 per cent of the weight of the immature insects taken in the collections from Middle Quiver Lake. This species did not occur in the collections from Lake Chautauqua, and only one specimen of Hexagenia sp. was collected at Lake Matanzas.

Fingernail clams and water-breathing snails flourished in Quiver Lake in 1952. After 1952 the molluscan population of that lake declined sharply. Mollusca formed only a minor part of the bottom fauna of Lake Chautauqua and Lake Matanzas.

Leeches were abundant in Quiver Lake in 1952; however, a drastic decline occurred after 1952 which tended to parallel the decline of the small mollusca population. No leech was taken from Middle Quiver Lake after 1954.

A reduction in numbers of lesser scaup ducks using Quiver Lake occurred following a decline in the population of small mollusca of that lake.

Findings in the present study reveal some drastic changes in the bottom fauna of Quiver Lake and Lake Matanzas since 1914 and 1915. The most drastic change since that time has been the great increase in Oligochaeta. A similar change has occurred in Quiver Lake. At Lake Matanzas the mollusca population has become greatly reduced since 1915 and the dipterous larvae population has increased. Siltation and other forms of pollution were considered important factors in the drastic changes that have occurred in the bottom fauna of the lakes studied. (From auth. summ.)

4029. Fraser, J. H. 1961. USE OF POLYETHYLENE GLYCOL IN BIOLOGY. Nature, Vol. 189, No. 4760, pp. 241-242.

In addition to Lamb's technique for the dry storage of algae on cards, the following uses of polyethylene glycol are envisaged.

Specimens of those types that recover well can be sent dry by post without special packing, and with a much-reduced risk of loss due to breakage of the jar or other container, and no risk of damage by leaking formalin to other goods in the post. Delicate or intricate specimens can be sent in a block of polyethylene glycol with no risk of displacement of parts.

Micro-specimens can be sent dry, on a slide, to be recovered at the destination in such a form that they can be handled or examined by any desired technique.

Parts of specimens dissected in a 30 per cent solution cannot come to harm by drying in transfer to the slide from a needle point, nor will they, or the specimen, be harmed if the observer has to leave his work to attend to something unexpected and of immediate priority. If this should result in his being unable to return to the work until after it has dried up, there is then no difficulty in resuming.

Even carefully sealed museum tubes are liable to dry if not examined at regular intervals, and a minute crack, unseen at the time can result in the complete loss of the specimen for most purposes. If preserved with polyethylene glycol added, there is a good chance that the loss would not be serious, and a little more polyethylene glycol than the equivalent volume of the specimen simply added to the preservative should be a worthwhile insurance. (Auth.)

4030. Schoffman, Robert J. 1961. AGE AND RATE OF GROWTH OF THE CHANNEL CATFISH IN REELFOOT LAKE, TENNESSEE, FOR 1953 AND 1960. Journal of the Tennessee Academy of Science, Vol. XXXVI, No. 1, pp. 7-11.

The study of age and growth of channel catfish in Reelfoot Lake, Tennessee, has extended over a period of eight years. During this period there has been a decrease in length and weight. During the last five years of this period, there has been no commercial fishing of game fish. In 1955 when commercial fishing was abolished those who advocated it predicted more and larger fish. However, this has not been shown by the studies of Schoffman (1959 and 1960). There has been an increase in the number of bluegills and white crappies caught by sportsmen but a decrease in length, weight, and age groups, the younger age groups having the largest number of specimens. This is also true of channel catfish, the length, weight, and age groups decreasing and the younger age groups having the largest number of specimens. The number of channel catfish is not increasing but the increase of other species along with the intensive fishing of this species is without doubt the cause of this decrease. Prior to 1959 Reelfoot Lake was able to supply large channel catfish to the eating places around the Lake, as well as outside markets. This past year the large channel catfish supplying the above markets were imported from the Tennessee River. Reelfoot Lake has an increasing population of small fish. The sportsmen's catch has increased in quantity and decreased in quality. This condition will continue until sportsmen no longer want small fish. By this time will it be too late to rectify this condition? Should fishing regulations remain as they are or should Reelfoot Lake be open for commercial fishing of both game and rough fish as prior to 1955? The author believes commercial fishing should be as prior to 1955 (Schoffman, 1950). (Auth. concl.)

4031. Phillips, R. C., and V. G. Springer. 1960. OBSERVATIONS ON THE OFFSHORE BENTHIC FLORA IN THE GULF OF MEXICO OFF PINELLAS COUNTY, FLORIDA. The American Midland Naturalist, Vol. 64, No. 2, pp. 362-381.

Marine algae were collected on limestone reefs in water 35-60 feet deep in the Gulf of Mexico off Pinellas County, Florida, over a period of one year. SCUBA type diving equipment was used.

Two depths ranges were chosen, owing to the assemblage of plants found in each. The first was 35 - 40 feet, and the second was 45 - 60 feet. Ninety-five taxa were found in 35 - 40 feet in eight collections. One hundred and eleven taxa were found in 45 - 60 feet in twelve collections. A total of 158 taxa of plants were found during the study. The red algae, though high in species numbers, were small in biomass in both depths. However, when metal wrecks were encountered, it was observed that the biomass of red algae was large. Sargassum filipendula, owing to the regularity with which it was found in 35 - 40 feet, is considered a characteristic plant in this depth range. No other algal complex or species was observed to dominate on the reefs in this depth.

Vast carpets of Halimeda scabra were observed at most of the 45 - 60 feet stations. This species was observed to be characteristic of this depth.

The epiphytic flora, a large percentage of which were red algae, accounted for nearly one-half of the total number of species found.

Eleven species are newly reported for the state, and 47 represent northward range extensions from the Dry Tortugas.

On the basis of this study and comparison with the results of Taylor's (1928) work at the Dry Tortugas, a more or less constant relationship between the various algal groupings can be seen. Although different species are included in the two areas, those relationships seem to denote that they are more than just a function of the number of possible species. The factors which might regulate relationships are unknown to us. (Auth. summ.)

4032. Paschalski, J. 1960. THE USE OF BUFFERING CURVES IN THE CHARACTERIZATION OF LAKE. (ZASTOSOWANIE KRZYWYCH ZBUFOROWANIA DO CHARAKTERYSTYKI JEZIOR.) Polskie Archiwum Hydrobiologii, Vol. VIII, No. XXI, pp. 165-182.

The buffering power of the waters studied was determined according to Weiser (1948) by the gradual acidification of one sample and the alkalization of a second sample. The changes in reaction were represented graphically as buffering curves. The acidification of samples which had already been alkalized gave new curves which are here called "secondary" curves.

Buffering curves of the lakes studied when compared with the types of curves given by Weiser (1948) for water from oligotrophic, eutrophic and dystrophic ponds showed that buffering curves for water from the lakes of northeastern Poland, do not correspond to that type of curve given by Weiser (1948). This is probably connected with the greater hardness of the waters of lakes. Weiser (1948) gave a type of oligotrophic curve on the basis of the determination of the buffering power of water from the ponds lying mainly on a gneiss substratum. The Lake Districts mentioned above lie on a post-glacial deposit which in turn lies on cretaceous ones and so the water connected with them has a somewhat increased calcium content and hardness. However, the estimation of the buffering power of the oligotrophic lakes in the Tatra Mountains which lie on the crystalline core of this range, gave a curve closely related to the curves given by Weiser (1948). It is further established that buffering curves for eutrophic lakes differ considerably from Weiser's curves in particular in the shape and position with respect to the coordinate system. They lie nearer to the horizontal axis. However dystrophic curves are similar to the dystrophic curves given by Weiser (1948) but they exhibit greater buffering power against alkalization, which is probably connected with the marked acidification of the water by peat-bog (Sphagnum).

While using secondary curves, for the more accurate characterization of the type of the water reservoir, their use in determining the grade of eutrophication was established. These differences were determined on the basis of the position and shape of the curve with respect to the primary curve and the coordinate system. However agreement with the find-

ings of Weiser (1948) was not obtained in all cases.

An analysis of material collected showed: 1) the differences in the buffering powers of the surface and bottom waters of lakes during the summer stagnation; 2) changes in buffering power of lake water for consecutive years during the summer stagnation; 3) changes in the buffering power of lake water during the course of the year.

The results obtained show that the method of buffering curves may be used for the characterization of lakes and as an indicator of the chemical changes occurring in lake water during consecutive seasons of the year and consecutive years. (Auth. summ.)

4033. Smirnov, A. I. 1959. INTERGENERIC HYBRIDIZATION OF PACIFIC SALMON. (MEZHRODOVAIA GIBRIDIZATSIIA TIKHOOKEANSKIKH LOSOSEI.) Priroda, 6, pp. 98-100; Fisheries Research Board of Canada, Translation Series No. 251.

Hybrids of female Siberian char and male coho results in cyclops-like embryos and is not a suitable cross for fish culture.

4034. Shearer, W. M., and Dr. E. Trewavas. 1960. A PACIFIC SALMON (ONCORHYNCHUS GORBUSCHA) IN SCOTTISH WATERS. Nature, Vol. 188, No. 4753, Dec. 3, 1960, p. 868.

A specimen of Oncorhynchus gorbuscha was caught in a salmon bagnet at Altens fishing station near Aberdeen, Scotland, July 16, 1960. It is assumed that this specimen originated from a Russian stocking of one of the rivers of the Kola Peninsula.

4035. Wolf, Ken, M. C. Quimby, E. A. Pyle, R. P. Dexter. 1960. PREPARATION OF MONOLAYER CELL CULTURES FROM TISSUES OF SOME LOWER VERTEBRATES. Science, Vol. 132, No. 3443, pp. 1890-1891.

Cold trypsin dispersion at pH 7.2 was used to obtain cultivable cells and cell groups from tissues of six species of fresh-water bony fishes, a frog, and a turtle. The cells readily attached to glass and were capable of at least limited, and in some cases extended, division in media consisting of commercially available components. (Auth. abst.)

4036. Mather, Frank J., III, and Howard A. Schuck. 1960. GROWTH OF BLUEFIN TUNA OF THE WESTERN NORTH ATLANTIC. U. S. Fish and Wildlife Service, Fishery Bulletin 179, Vol. 61, pp. 39-52.

Growth of bluefin tuna Thunnus thynnus (Linnaeus) based on specimens captured mostly in the Cape Cod and Long Island areas was studied by counting annuli on scales and vertebrae and by analyzing length-frequency data. Similar results obtained by these two methods support their validity for ages 0-4. Older ages were determined by counting annuli only, but tag returns and weight-frequency data afford some corroboration for ages 5-7. Growth is believed to be extremely rapid during the first summer and about four-fifths of an inch per month in the first winter. During the next 3 1/2 years, bluefin tuna grow at a rate of about 1 1/4 inches per month in summer and about one-third of an inch per month in winter, or about 7 inches per year. Tables of estimated sizes for each month of the first 5 years of life, and at midsummer through the age of 10 years, are presented. The growth rate appears to decline gradually to about 4 inches per year in this range. Only slight differences were found between the sizes and growth rates of fish of the same age taken in different years. (Auth. abst.)

4037. Rathjen, Warren F., and James L. Squire, Jr. 1960. THE OCCURRENCE OF THE WAHOO IN THE NORTHWEST ATLANTIC. Deep-Sea Research, Vol. 7, No. 3, pp. 220-222.

Twenty-one wahoo, Acanthocybium solanderi (Cuvier) were taken on long-line at 15 offshore stations between the latitude of the Grand Banks and the latitude of the Bermuda Islands. The majority were taken in the general vicinity of the Gulf Stream at locations where the water temperatures ranged from 71.8 F. to 83.0 F.

4038. Larimore, R. Weldon. 1961. FISH POPULATION AND ELECTROFISHING SUCCESS IN A WARM-WATER STREAM. The Journal of Wildlife Management. Vol. 25, No. 1, pp. 1-12.

An electrofishing census was made of the fish in a 1-mi. section of Jordan Creek, a small warm-water stream in east-central Illinois. The stream flow was then diverted with pumps and the fish missed in electrofishing were poisoned and collected. This procedure permitted a virtually complete census of a highly diversified fish population and made possible an evaluation of certain biological factors influencing electrofishing in a varied stream habitat.

The fish population was 24,938 fish weighing 163.91 lb. per surface acre of water, or 42,862 fish weighing 281.72 lb. per acre-foot of water. The minnow family was the most numerically abundant, and longear sunfish made up the maximum total weight for any one species in the population. Shallow sections produced greater numbers of fish but less weight per unit of area or volume of water than did deep sections.

Efficiency of electrofishing was directly affected by the behavior of each species, by their habitats, and by their morphological peculiarities. No definite efficiency factor for the electric shocker can be established for general use in a stream with such a highly diversified fish population and habitat as Jordan Creek.

4039. Yashouv, A. 1960. EFFECT OF LOW TEMPERATURES ON TILAPIA NILOTICA AND TILAPIA GALILAEA. Bamidgeh, Vol. 12, No. 3, pp. 62-66.

In summarizing the results of the spell at the Experimental Station, T. galilaea appears to be more sensitive to cold than T. nilotica. In all ponds with a mixed Tilapia population, the whole population of T. galilaea was killed while some of the T. nilotica survived. On inspection of the dead fish, it appears that T. galilaea were also affected earlier than T.

nilotica.

T. nilotica begins its spawning activity when water temperatures reach 20°C. At temperatures lower than 10°C, movement ceases and at 8°C cold stupor sets in. With further lowering of temperature, the respiratory movements become sluggish and at 6°C--7°C the fish loses equilibrium. Water temperature of 5°C which caused mortality in ponds in 1958, will not prove fatal if the fish are exposed a few hours only. (Auth.)

4040. Yashouv, A., and J. Chervinski. 1960. EVALUATION OF VARIOUS FOOD ITEMS IN DIET OF T. NILOTICA. Bamidgeh, Vol. 12, No. 3, pp. 71-78.

We evaluated various food items by means of the specific growth rate of the fish and efficiency of flesh production from food consumed (nutritional coefficient).

On analysis, the effect of the differences in size noted on the growth rate was considerable, although the differences from fish to fish has not exceeded 3-4 gr.

Also, on comparing the experiments in net-covered boxes with those carried out in aquaria, the growth rate appears to be limited in the aquaria due to the environmental influence. It was shown that T. nilotica, even of 2.5 g. weight, feeds in addition to plankton on water bugs and other insects and is capable of assimilating even cotton seed-oil cakes.

Comparison of the growth rate of fish with request to the size of food portion and its digestability show that the value of water bugs and chironomids is greater than that of plankton while that of cotton-seed oil cakes falls below the others. The natural food spectrum of the T. nilotica appears to be very wide. (From auth. summ.)

4041. Fink, Bernard D., and Glen B. Haydon. 1960. SPERM MORPHOLOGY OF TWO COTTID FISHES IN ELECTRON MICROGRAPHIC SILHOUETTES. Copeia, 1960, No. 4, pp. 319-322.

A study of the sperm of two very closely related species of cottid fishes was made utilizing the electron microscope. It represents what is hoped will be the beginning of a study to determine the relationship of sperm morphology seen in electron micrographic "silhouettes" to the systematics of the group. The size ranges of the sperm and their parts were measured and compared. The spermatozoa of Oligocottus snyderi are considerably smaller but relatively thicker than those of O. rubellio. It is suggested that the extremely long period of viability found for the sperm of O. snyderi when subjected to the external environment may be related to the secretion of accessory reproductive glands forming a "sheath" about the sperm, the specific nature of which is unknown. (Auth. summ.)

4042. Moore, H. B., and John C. Bauer. 1960. AN ANALYSIS OF THE RELATION OF THE VERTICAL DISTRIBUTION OF THREE COPEPODS TO ENVIRONMENTAL CONDITIONS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 10, No. 4, pp. 430-443.

The vertical distribution of three species of copepods has been determined from about 400 net hauls. This is analyzed in terms of temperature, illumination, pressure, and a seasonal cycle probably associated with successive broods. Variations of behavior within the populations are demonstrated as well as diurnal rhythms in behavior. (Auth. abst.)

4043. Robins, C. Richard, and Donald P. DeSylva. 1960. DESCRIPTION AND RELATIONSHIPS OF THE LONGBILL SPEARFISH, TETRAPTURUS BELONE BASED ON WESTERN NORTH ATLANTIC SPECIMENS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 10, No. 4, pp. 383-413.

Tetrapturus belone Rafinesque is described on the basis of specimens from the Western North Atlantic. A synonymy is given and the relationships discussed. The species is compared with other Atlantic billfishes and with T. angustirostris of the Indo-Pacific. T. angustirostris is recorded for the first time from off the Chilean coast. The genus Tetrapturus is redefined, its synonymy given and the constituent species of Istiophoridae realigned according to a proposed phylogeny. A key is given to the species of Istiophoridae exclusive of the sailfishes, Istiophorus. (Auth. abst.)

4044. Rall, David P., Paul Schwab, and Charles G. Zubrod. 1961. ALTERATION OF PLASMA PROTEINS AT METAMORPHOSIS IN THE LAMPREY (PETROMYZON MARINUS DOSATUS). Science, Vol. 133, No. 3448, pp. 279-280.

Coincident with metamorphosis in the lamprey (Petromyzon marinus dosatus), a new, more rapidly moving plasma protein component appears. In the mature lamprey this new component is of major quantitative importance. With paper electrophoretic mobility as the sole criterion, the new component is considered to be an alpha globulin rather than albumin. (Auth. abst.)

4045. McBroom, James T. 1961. FISH AND WILDLIFE IN SMALL WATERSHEDS. Journal of Soil and Water Conservation, Vol. 16, No. 1, pp. 21-24.

The Watershed Protection and Flood Prevention Act and amendments are discussed. The fish and wildlife conservation measures authorized for cost sharing are described. Examples of projects which include fish and wildlife developments are given.

4046. Campbell, R. Niall. 1961. THE GROWTH OF BROWN TROUT IN ACID AND ALKALINE WATERS. The salmon and Trout Magazine, No. 161, January 1961, pp. 47-52.

A study of brown trout in nine small highland lakes indicated that there was no relation between total alkalinity and trout growth. In comparing trout growth with spawning facilities, it was found that in the lakes with poor spawning tributaries the growth of trout was good while the opposite was true in lakes

with good spawning facilities.

4047. Miller, Jack, and Keen Buss. 1961. THE AGE AND GROWTH OF THE PUMPKINSEED IN PENNSYLVANIA. PART V. Pennsylvania Angler, Vol. 30, No. 2, pp. 8-9.

The age and growth of the pumpkinseed, Lepomis gibbosus, in 14 Pennsylvania lakes is listed.

4048. Kimata, Masao, Akira Kawai, and Yuzaburo Ishida. THE METHOD FOR SAMPLING OF MARINE BOTTOM MUDS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 12, pp. 1227-1230.

The biochemical and microbiological properties of bottom muds in a bay or an inland sea may vary owing to the slight differences in layers of muds. In sampling, therefore, the layer of muds must not be disturbed and should be taken as is. Using the ordinary sampling apparatus, the layer of muds is disturbed.

In this paper, the simple core-sampler fitted for the purpose is designed, and an example of analytical data of the bottom muds taken from Maizuru bay with this apparatus is shown. (From auth. abst)

4049. Uno, Michio, and Tuneo Konagaya. 1960. STUDIES ON THE SWIMMING NOISE OF THE FISH. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 11, 1960, pp. 1069-1073.

The swimming noise of a single fish and a fish school was studied.

Single fish: The sound was produced when a fish swam just below the surface of the water or jumped up from the water, but could not be detected when it swam under water.

Fish school: When the fish school was approaching the hydrophone in a pond, the sound was distinctly noticeable over the background noise. But in yellowtail crawl, it was not heard. In a pond or crawl, certain low frequency sounds were produced by sudden movements, jumping, and preying of the fish.

Skipjack fishing: When a skipjack was angled, the sound was observed, but it was not observed when they were approaching the prey. In operating the fishing boat, the noise was very loud, and the sound pressure produced by showering was very high.

4050. Morooka, Hitoshi. 1960. DETERMINATION OF SEA WATER POLLUTION - II. SURVEY ON THE WATER QUALITY WITH B. O. I. AS A POLLUTION INDICATOR. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 12, pp. 1147-1151.

This study was conducted to clarify the significance of a new indicator (B. O. I. -Biological Oxygen Index), which had been assumed as an indicator of sea water pollution caused by microorganisms, and the following results were obtained.

Many fishes of N Aquarium died last summer. Although no abnormality was found by chemical analysis, the value of B. O. I. revealed that there were many microorganisms. It is easily conceivable that microorganisms cannot proliferate in the culture water, from the fact that the value of B. O. D. or C. O. D. of the culture water is small. The microorganisms which play an important part of the origin of the B. O. I. grow on the body of some fishes and make them die, and then spread to some other fishes through the culture water.

As the results of a survey on the quality of the waste water from starch factories, that might badly affect fishes, the author reached the following conclusion.

In the areas where waste water flows in and tidal currents wash, the value of C. O. D. or B. O. I. indicates somewhat wider polluted areas than the value of pH or B. O. D. does. But the area is not so spread. In such a case, organic substances are decomposed but microorganisms are left alive.

In the areas where waste water flows in but tidal currents do not affect, pH, D. O. and B. I. I. reveal nearly the same results in extent of spreading, and the area is so spread. In such a circumstance, waste water that spreads and pollutes sea water, seems not to be usually diluted and the organic matter decomposed in the same area. (Auth. abst.)

4051. Olund, Leonard J., and Frank Bernard Cross. 1961. GEOGRAPHIC VARIATION IN THE NORTH AMERICAN CYPRINID FISH, HYBOPSIS GRACILIS. University of Kansas Publications, Museum of Natural History, Vol. 13, No. 7, pp. 323-348.

Description of subspecies, intraspecific variation and some aspects of life history discussed.

4052. Deacon, James E., and Artie L. Metcalf. 1961. FISHES OF THE WAKARUSA RIVER IN KANSAS. University of Kansas Publications, Museum of Natural History, Vol. 13, No. 6, pp. 309-322.

An annotated list of species.

4053. Walker, Boyd W. 1960. THE DISTRIBUTION AND AFFINITIES OF THE MARINE FISH FAUNA OF THE GULF OF CALIFORNIA. Systematic Zoology, Vol. 9, Nos. 3 and 4, pp. 123-133.

The fish fauna of the Gulf of California is clearly part of the Panamic fauna, but it has certain peculiarities and distinctive elements which characterize it. Seventy-three per cent of the fish fauna of the Gulf consists of Panamic elements, 10% is of northern elements, and 17% is endemic. As compared to the region to the south, there is an unusually high number of rocky shore species, and a relatively poor representation of those forms that live on mud or mud and sand.

Although endemic species are numerous, there are only four endemic genera, all monotypic. (From auth. summ.)

4054. Regan, James D. 1960. MELANISM IN THE POECILIID FISH, GAMBUSIA AFFINIS (BAIRD AND GIRARD). American Midland Naturalist, Vol. 65,

No. 1, pp. 139-143.

Integumentary melanophores in normally-pigmented Gambusia affinis are of two types: a scale melanophore found in the epidermis covering the scales and a stellate micromelanophore which is found in the dermis. Melanistic individuals also possess macromelanophores in the dermis. Melanism appears to be confined to males of the species and the degree of melanism varies greatly. Collections totaling 3,002 fish from three localities in southern Florida contained significantly different percentages of melanistic individuals among the recognizable males. Six F_1 males, progeny of matings of melanistic males with normally-pigmented females, were reared to sexual maturity. All had only normal pigmentation. (Auth. abst.)

4055. Nelson, Edward M. 1961. THE COMPARATIVE MORPHOLOGY OF THE DEFINITIVE SWIM BLADDER IN THE CATOSTOMIDAE. American Midland Naturalist, Vol. 65, No. 1, pp. 101-110.

The definitive swim bladder of the Catostomidae has been described and its variations noted. It is characteristically the two-chambered type found in cypriniform fishes in general and described by Tracy as Group 2.

The anterior chamber is encased in a tunica externa made up of special connective tissue fibers. This tunic is in two layers and the fibers of these layers are arranged at right angles to each other. It is proposed that this arrangement prevents over-expansion of the anterior chamber and thus maintains free range-of-motion for the Weberian ossicles.

The usual catostomid swim bladder is 35 - 45 per cent of the standard length of the individual. Hypentelium, adapted to riffle-type life, has the posterior chamber somewhat reduced. Thoburnia and Pantosteus, adapted to mountain streams, have the posterior chamber even more reduced.

The Moxostoma genus-group (Moxostoma, Placopharynx, Megapharynx and Lagochilia) has a three-chambered swim bladder. Thoburnia and Hypentelium are retained as separate genera of the Moxostomatini, being more primitive, although specialized, than the former. (Auth. abst.)

4056. Purko, John, and Helen I. Battle. 1961. EFFECTS OF SOME PURINES ON DEVELOPMENT OF THE BROWN TROUT (SALMO TRUTTA FARIO L.). Canadian Journal of Zoology, Vol. 39, No. 1, pp. 73-79.

Recently fertilized eggs of the brown trout (Salmo trutta fario L.) were subjected to each of the purines adenine and hypoxanthine in concentrations ranging from 0.025 to 0.150% for periods up to 21 days at 9.5°C. Measurements of blastomere diameters during cleavage, of blastoderm diameters during blastulation, and of the lengths of the embryonic axes during and subsequent to gastrulation indicated that over the whole range of concentrations of both purines, these processes were significantly accelerated over those of controls. Adenine and hypoxanthine appear to be equally effective. It is concluded that an exogenous source of the purines adenine or hypoxanthine can exercise a general acceleration of the processes of cleavage, blastulation, gastrulation, and early differentiation in the brown trout embryo. (Auth. abst.)

4057. Radovich, John. 1961. RELATIONSHIPS OF SOME MARINE ORGANISMS OF THE NORTHEAST PACIFIC TO WATER TEMPERATURES, PARTICULARLY DURING 1957 THROUGH 1959. California Department of Fish and Game, Marine Resources Operations, Fish Bulletin No. 112, 62 pgs.

Sea-surface temperatures at Scripps Pier, La Jolla, and in the 5-degree squares of latitude and longitude adjacent to southern California and northern Baja California were quite similar when compared for an eighteen-year period. Therefore, sea temperatures from Scripps Pier were considered indicative of coastal ocean temperatures.

Ocean temperatures off the Pacific coast of North America were high during 1925, 1931 and 1941.

Southern organisms, primarily fish, moved northward during 1926, 1931, and 1941.

Water temperatures were very low in 1933 and during the years 1948 through 1956, were colder than the long-term average.

Ocean conditions apparently were warm about 100 years ago (during the 1850's). At that time, warm-water species were observed farther north than during recent years.

During 1957, the ocean climate along the California coast warmed up and many fish ranged north of their usual haunts. Some warm water species were caught in large quantities off California.

In 1958, high catches of southern game fish continued and for some even increased. Twenty-three fish species were taken north of their usual range, 10 farther north than ever previously recorded.

Warm water and northerly distributions of game species continued during 1959 and 26 fish species were recorded north of their usual range. Eleven of these represented northern records and six were additions to the marine fauna of California.

Some rare species captured during 1957, 1958 and 1959 showed no latitudinal movement; and some fish were caught south of their usual range.

There is some evidence suggesting seaward movements of striped bass are influenced by the ocean temperatures adjacent to the inland waters.

Yellowtail and barracuda distribution and fishing success off California are strongly influenced by the ocean temperatures.

Local fishing success for other warm water species such as bonito and yellowfin tuna seems to be affected by sea temperatures.

During the recent warm years, white seabass redistributed themselves to areas off the northern part of the state where they were abundant about 70 years ago.

Although water temperatures seem to affect

sardine distribution, the collapse of the Pacific sardine fishery cannot be attributed entirely to a southerly movement of fish caused by a drop in water temperature.

The latitude at which albacore approach the North American west coast seems related to ocean temperatures.

Many other animals, including sea turtles and numerous kinds of plankton, were distributed northward of their usual range during the warm period.

During the three years, the northward redistribution of planktonic and partially planktonic forms including doliolids, pelagic red crabs and sand crabs, demonstrated existence of a countercurrent, in addition to warming of the environment north of their usual ranges.

Several southern marine species spawned successfully off California during the period 1957 through 1959.

The distributions of whales, sea birds, and kelp also seem to be affected by ocean temperatures. (Auth. summ.)

4058. Follett, W. I. 1960. THE FRESH-WATER FISHES - THEIR ORIGINS AND AFFINITIES. Systematic Zoology, Vol. 9, Nos. 3 and 4, pp. 212-232.

The indigenous fishes that are known from fresh water in Baja California are referable to 17 families, 25 genera, and 29 species. All but Xyrauchen, Gila, Ptychocheilus, and perhaps Cyprinodon, are of marine affinities. The single endemic species is Fundulus lima.

With the exception of the one endemic species, there exists no such discrete assemblage of fishes as might strictly be designated the fresh-water fauna of Baja California. (Auth. intro.)

4059. Schiffman, R. H. 1961. A PERFUSION STUDY OF THE MOVEMENT OF STRONTIUM ACROSS THE GILLS OF RAINBOW TROUT (SALMO GAIRDNERII). The Biological Bulletin, Vol. 120, No. 1, pp. 110-117.

A perfusion technique for the study of transport across the intact gill of rainbow trout is described.

It was found that the outflux rate of 1.6×10^{-6} cm./sec. was greater than the influx rate of 5×10^{-8} cm./sec. for strontium, and that strontium would go out of a fish gill against a concentration gradient under these experimental conditions. (Auth. summ.)

4060. Hikita, Toyoshiko, and Ariaki Nagasawa. 1960. BIOLOGICAL OBSERVATIONS OF MEMU STREAM, TOKACHI RIVER SYSTEM. THE DAMAGE OF SALMON EGGS AND FRY BY PREDACEOUS FISHES. Scientific Reports of the Hokkaido Salmon Hatchery, No. 15, pp. 69-83.

More than 13, 374 fish were collected during 1955-59 from various parts of the stream and the salmon counting fence at the spawning ground in the upper stream. The contents of the stomachs of predatory specimens collected were examined and found to contain a high percentage of salmon eggs and fry.

It deals specifically with the feeding habits of four species, Rainbow trout (Salmo gairdneri irideus), Land-lock sasou salmon (Oncorhynchus masou). Common dace (Tribolodon hakanensis) and Sculpin (Cottus nozawae). The bulk of the specimen were Cottus. In the contents of 956 stomachs were found many aquatic insects each month and fry and eggs of salmon in season. The behaviour of Cottus at the season of their capture is important in interpreting the predator status of salmon farming. The best time to study Cottus is from October to December when the salmon is spawning and February to May when the salmon fry are released at the salmon hatchery.

Almost three years investigation showed that of 742 stomachs examined 4.56 per cent contained salmon eggs and out of 442 stomachs examined 5.42 per cent contained salmon fry.

From observations of Cottus, it is known that the number of fry captured is dependant on the size of the Cottus, the length of time they were in the salmon area and the density of the prey. (Auth. abst.)

4061. Hikita, Toyohiko. 1960. BIOLOGICAL OBSERVATIONS OF MEMU STREAM, TOKACHI RIVER SYSTEM. THE FRESHWATER FISHES AND ITS ENVIRONMENT. Scientific Reports of the Hokkaido Salmon Hatchery, No. 15, pp. 47-67.

Since 1955, the predation of freshwater fishes on salmon eggs and fry has been investigated as a part of the natural spawning programs of chum salmon in Memu stream, a tributary of Tokachi river. The stickleback is the most dominant, having a wide distribution and occurring in great numbers in this stream. Sculpin, lamprey and dace are commonly collected by a scoop-net or gill net the year round. The predatory fishes harmful to salmon eggs and fry in the stream are: sculpin, rainbow trout, masou salmon and common dace. When we compare the chum fry specimens of the same age in the stream, it seems highly probable that the natural fry grows more rapidly than the artificial one. Memu stream provides not only very suitable environment for the natural spawning of chum salmon, but also suitable inhabitancy for other freshwater fishes.

4062. Sakano, Ei-ichi. 1960. RESULTS FROM MARKING EXPERIMENTS ON YOUNG CHUM SALMON IN HOKKAIDO, 1951-1959. Scientific Reports of the Hokkaido Salmon Hatchery, No. 15, pp. 17-38.

A program of marking experiments on Chum salmon fry was begun in 1951 in Hokkaido to determine the number of returning salmon to various areas. Through 1959 five rivers were examined. It is evident that the marked adult is captured in limited areas, and the number of recaptured fish differs considerably by rivers from which the marked fish were released. (Auth. abst.)

4063. Hikita, Toyohiko. 1960. ON THE CHINOOK SALMON EGGS, ONCORHYNCHUS TSCHAWYTSCHA (WALBAUM), FIRST PLANTED IN HOKKAIDO,

JAPAN. Scientific Reports of the Hokkaido Salmon Hatchery, No. 15, pp. 1-6.

The chinook salmon, Oncorhynchus tschawytscha, is one of the most valuable resources in the Columbia River and in many other rivers along the coast of the State of Washington. In Japan, little is known of the distribution of this species in her mainland. But they occasionally migrate off the coast around Hokkaido, especially along the Pacific side, every year.

In October of 1959 one hundred thousand eyed eggs of this salmon were presented to our hatchery on the occasion of the 80th Anniversary of the Hokkaido Salmon Hatchery through the courtesy of the Washington Department of Fisheries. The present paper deals with the result of the transplantation of this salmon in Hokkaido.

About 70,000 eggs were immediately transported to the Satsunai hatchery, Tokachi District, for hatching and raising until liberation. The remainder was placed in the Chitose hatchery, for hatching using the vertical incubator. The young at Chitose were reared until the following year in the rearing ponds which were prepared for experimental purpose, particularly for the study of regeneration and growth of marked fish. These marked fingerlings are ready to be released into some suitable streams after sufficient investigations.

4064. Minckley, W. L., and Louis A. Krumholz. 1960. NATURAL HYBRIDIZATION BETWEEN THE CLUPEID GENERA DOROSOMA AND SIGNALOSA, WITH A REPORT ON THE DISTRIBUTION OF S. PETENENSIS. Zoologica, Vol. 45, Part 4, December 31, 1960, Numbers 10 to 13, pp. 171-180.

This paper concerns the first known natural hybrids between the gizzard shad, Dorosoma cepedianum (LeSueur), and the threadfin shad, Signalosa petenesis (Gunther). Six specimens of this hybrid combination, all from the Ohio River, are compared with 25 specimens of each parental species from the same general area. The hybrids were intermediate in most proportional and meristic characters examined; however, in characters involving plumpness of body and development of fins, the hybrids were extreme. The extreme development of these characters is attributed to complementary action of genes. Basic color patterns of the hybrids resembled Signalosa more closely than Dorosoma, but mingling of the two patterns was obvious.

Signalosa is a recent invader of the Ohio River Basin, and a review of the current distribution of the species is included. The recent invasion of the Ohio River Basin by one species, the modifications of that basin by man's activities, and the relative rarity of Signalosa are probably all contributory to the breakdown of the isolating mechanisms between these two clupeids, and the subsequent miscegenation. (Auth. summ.)

4065. Harrington, R. W., Jr., and E. S. Harrington. 1960. FOOD OF LARVAL AND YOUNG TARPON, MEGALOPS ATLANTICA. Copeia, 1960, No. 4, pp. 311-319.

The predominant food items of tarpon ranging in size from 16.0 mm. standard length (mid-metamorphic larvae) to 75.0 mm. (young-of-the year), and to somewhat larger size, are cyclopoid copepods and small fishes. These two items, on the average, make up over 95% of the total volume of food throughout this range of tarpon sizes. At the small end of the range (16-25 mm. S. L.), copepods (cyclopoid, 95.66%; harpacticoid, 1.48%) make up 97% of the total food volume, which points to the possibility that copepods are the staple of the early-metamorphic larvae and of the leptocephali as well. At the large end of the range (66-75 mm. S. L.), fishes make up about 32% and cyclopoid copepods about 58% of the total volume; the remainder (about 10%) is largely Palaemonetes shrimp, which are probably unavailable to the smaller tarpon because of their comparatively large size. At 10-millimeter intervals of standard length between the two extreme length classes considered, the sums of cyclopoid copepod plus forage-fish volumes vary between 97-98% of the total food volumes, but there is a remarkably consistent increase in the percent volumes of fishes, at the expense of the percent volumes of cyclopoid copepods. These two items appear to be omnipresent in the habitats studied, and to have become obligatory items of the small tarpon diet. The remaining organisms are either of more transitory occurrence in the habitat or of more transitory availability because of their respective definitive sizes. Chief among the subordinate, intercalary items on the menu of small tarpon locally are saltmarsh mosquitoes of the species Aedes taeniorhynchus and shrimp of the species Palaemonetes intermedius. The former are preferred by the smaller, and the latter are restricted to the larger tarpon of this size range, but both taxa are replaced by a moderate variety of alternative food organisms, as the availability of the two primary subordinate food items changes, either through fluctuations in their numbers or with the increasing capacity for larger organisms of the rapidly growing tarpon. (Auth. summ.)

4066. Gainor, Charles. 1960. A NEWLY DESIGNED APPARATUS FOR WATER SAMPLING AT SHALLOW DEPTHS. Ecology, Vol. 41, No. 4, pp. 794-797.

Although this sampler was designed primarily for use in bodies of water to 2 m in depth, it is suitable for several other applications. It might be convenient for collecting samples from various stages in water or sewage treatment plants. It could also prove useful for industrial processes, such as vat and tank sampling.

A similar sampler could be built by almost anyone. All its parts are easily obtainable, and its construction does not require special mechanical tools or skills. It is expensive enough not to strain a limited budget; the total cost for parts was less than $8. It has, moreover, been used successfully for more than a year without developing operational

flaws. (Auth.)

4067. Starrett, William C., William J. Harth, and Philip W. Smith. 1960. PARASITIC LAMPREYS OF THE GENUS ICHTHYOMYZON IN THE RIVERS OF ILLINOIS. Copeia, 1960, No. 4, pp. 337-346.

A total of 453 specimens of parasitic lampreys belonging to the genus Ichthyomyzon was collected from the Illinois rivers, between 1949 and 1959.

Of the 453 specimens of Ichthyomyzon, only two species are represented, Ichthyomyzon unicuspis and I. castaneus. The former species was found to be most abundant in the East Dubuque-Savanna region of the Mississippi River and in the Wabash River; the latter, in the lower reaches of the Mississippi, Ohio, and Illinois rivers. Lampreys were scarce in the Savanna to Rockport section of the Mississippi and in the Illinois River above Florence. A partial explanation is provided by the absence of suitable spawning grounds in the tributaries over much of glaciated Illinois.

Apart from a certain amount of doubt regarding the interpretation of "moderately" versus "slightly" in describing the bilobation of the transverse lingual lamina, and slightly higher averages in myomere counts, there is no evidence that I. bdellium presently occurs in Illinois or extreme western Indiana. Nor is there evidence that a population of castaneus x bdellium occurs in the Wabash and lower Ohio rivers. It appears that I. bdellium has a more eastern distribution at present. Whether bdellium is specifically or subspecifically distinct from castaneus must await the availability of series from southern Indiana. (Auth. summ.)

4068. MacIntyre, Pamela A. 1960. TUMORS OF THE THYROID GLAND IN TELEOST FISHES. Zoologica, Vol. 45, Part 4, December 31, 1960, Numbers 10-13, pp. 161-170.

Several cases of spontaneous hyperplasia of the thyroid gland in the poeciliid fish, Girardinus falcatus, in which thyroid tissue had invaded the gills, are described; this condition was relieved by the addition of iodine to the aquarium water. A thyroid tumor in a specimen of Xiphophorus variatus variatus is described in which extensive growths were found in the pharyngeal area, spleen and body cavity. Many reports of spontaneous thyroid tumors in teleost fishes in captivity and a few in nature have been made. These are listed and discussed, with particular reference to the strong evidence for genetic susceptibility to this condition. (Auth. summ.)

4069. Breder, C. M., Jr. 1960. DESIGN FOR A FRY TRAP. Zoologica, Vol. 45, Part 4, December 31, 1960, Numbers 10 to 13, pp. 155-160.

The trap described was designed to catch fry and slightly larger fishes. Precise setting, as well as the size of its aperture, can greatly influence the type of fishes it will catch.

4070. Randall, John E., and Helen A. Randall. 1960. EXAMPLES OF MIMICRY AND PROTECTIVE RESEMBLANCE IN TROPICAL MARINE FISHES. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 10, No. 4, pp. 444-480.

Definitions of the terms mimicry and protective resemblance are given, and known examples of mimicry in fishes are discussed.

Further observations were made on the mimicry of the wrasse, Thalassoma bifasciatum, by the blenny, Hemiemblemaria simulus in Florida.

A strong case is made for the mimicry of the wrasse Labroides dimidiatus by the blenny Aspidontus taeniatus, based on observations of these fishes in the Society Islands. L. dimidiatus feeds primarily on crustacean ectoparasites of other fishes, including predaceous species. A. taeniatus closely resembles dimidiatus, swims with its pectoral fins like a wrasse, and feeds in part by tearing pieces from the fins of other fishes.

The striking similarity of the young of the sturgeonfish Acanthurus pyroferus to the gaudily colored angelfish Centropyge flavissimus would seem best explained in terms of mimicry; however, a biological basis remains to be found.

The resemblance of the serranid fish Hypoplectrus gemma to the damselfish Chromis cyanea in Florida is discussed as a possible case of mimicry. Mention is made of the superficial resemblance of other species of Hypoplectrus to damselfishes and surgeonfishes in the Virgin Islands. (Auth. abst.)

4071. Suetake, Toshio. 1955. ON THE RECORDING EQUIPMENT TAKING A COUNT OF SALMON-NUMBER BY THE UTILIZATION OF PHOTOELECTRIC CELL (PRELIMINARY NOTE). Scientific Reports of the Hokkaido Fish Hatchery, Vol. 10, No. 1, 2, pp. 73-81. December 1955.

An experimental device which used photoelectric cells was constructed to count fish passing a weir. The intensity of light and color of filter seemed to have no effect on fish behavior. Dry and wet cell batteries were used for power since the weirs were in remote areas without commercial electricity. The lamp was 5V-5a and consumed about 30w. It lacked a reflector, since one was unobtainable, and thus, required higher wattage. A commercially available battery pack (2.5-3.5 volts) would reduce the amount of electricity needed.

A thyraton, 66G (66GT), and a 606 pentode are used in the amplifier, but the vacuum tube photoelectric cell can be replaced by the type of photoelectric cell used in exposure meters for taking pictures and electric color comparing meters, etc., if the fish do not pass the orifice in rapid succession. Practically, if photo transistors, currently used in electric computors, and germanium triad transistors, which are now being manufactured in our country to replace the thyratrons, are used, it is possible to construct a fish counter which is small, light and consumes as little as one-hundredth of the electricity of the present device.

It is impossible to identify the sexes of the fish passed by this device, but this problem should be considered as a separate project. An automatic device for counting the number of fish passed can also be used

in the investigation of the salmon movement in rivers and streams.

4072. Leslie, P. H., and J. C. Gower. 1960. THE PROPERTIES OF A STOCHASTIC MODEL FOR THE PREDATOR-PREY TYPE OF INTERACTION BETWEEN TWO SPECIES. Biometrika, Vol. 47, Nos. 3 and 4, p. 219.

Considered are some of the properties of a model for the interaction between a predatory species and its prey, more particularly in regard to the behaviour of such systems in the region of the stationary state, and the chances of random extinction for one or other of the two species. The interaction is imagined to take place in some limited environment where there is an ample supply of food for the prey, and in the first place it is assumed that all the members of the prey population are exposed to the risk of capture or attack by the predator. Later, this last condition is relaxed, and it is supposed that because of some heterogeneity in the environment, only a fraction of the prey population is exposed to risk, and some of the consequences of this partial interaction are illustrated in the last section. (Auth. intro.)

4073. Tokui, Toshinobu. 1960. STUDIES ON THE KOKANEE SALMON. (III). FLUCTUATIONS IN ABUNDANCE OF THE SPAWNING KOKANEE SALMON OF LAKE SHIKOTSU, HOKKAIDO, JAPAN. Scientific Reports of the Hokkaido Salmon Hatchery, No. 15, pp. 7-16.

Lake Shikotsu is a large, deep, clear lake in southwestern Hokkaido, and is famous for the propagation of kokanee salmon. The salmon was first planted in the lake in 1894 from Lake Akan. It is native to only two lakes, namely, Lake Akan, Kushiro Prov. and Lake Chimikeppu, Kitami Prov. both in Hokkaido, where it is also called "Kapacheppo." "Kapa" means flat and "cheppo" a little fish in Aino, so "Kapacheppo" really designates the humpbacked form of spawning kokanee salmon. From 1898 through 1959 the annual spawning population of kokanee salmon in Lake Shikotsu has fluctuated in extreme manner. Various sources of fluctuations of spawning kokanee salmon were studied.

(1) The fluctuations are mainly caused by low production of this lake.

(2) Low production appears to be dependent upon a severe scarcity of nutrients in this deep lake.

(3) Direct addition of inorganic salts to increase production may be questionable.

(4) It is recommended that control of predaceous fish be tried on the lake in order to increase production of the salmon.

(5) It is recommended that biological experiments be continued on the lake to determine the optimal population density of released fry. (Auth. abst.)

4074. Szlauer, L. 1960. VERTICAL MIGRATIONS OF PLANKTON. (WEDROWKI PIONOWE PLANKTONU W SWIETLE BADAN SAMOLOWKOWYCH.) Polskie Archiwum Hydrobiologii, Vol. VIII, No. XXI, pp. 63-86.

The tendency of animal plankton to migrate upwards is on the whole proportionate to their sinking velocity.

Unsuitable breathing conditions, and poor light or darkness, increase in Cladocera and adult Copepoda their upward tendency.

Rotatoria and Copepoda nauplii react to unsuitable breathing conditions and poor light very much like adult crustaceans, but show no tendency to rise in darkness.

In deteriorating breathing conditions and illumination Rotatoria and nauplii restrict the zone of their migrations more than Cladocera and Copepoda.

During the day, zooplankton sinks to deeper layers, where they show fairly limited vertical oscillations. The location of this zone of oscillation depends on illumination and breathing conditions and on the individual characteristics of the animals, among which an essential role is played by the sinking velocity. (Auth. summ.)

4075. Sieburth, John McNeill. 1960. SOVIET AQUATIC BACTERIOLOGY: A REVIEW OF THE PAST DECADE. The Quarterly Review of Biology, Vol. 35, No. 3, pp. 179-205.

The importance of bacteria in oceans and lakes is slowly gaining recognition. The post-war Soviet studies on the Black Sea have led to the development of techniques which are being used in the "complex studies" being conducted on virtually all major water bodies of the world. These investigations, which are primarily concerned with the productivity of water basins, have led to some very interesting observations from "pole to pole". Included are studies such as the bacterial development in the region of the North Pole, chemosynthesis in water reservoirs, and the use of bacteria as hydrological indicators of Antarctic water masses. The purpose of this review is to draw attention to and discuss the nature and extent of Soviet work in aquatic bacteriology. (Auth. abst.)

4076. Colebrook, J. M. 1960. CONTINUOUS PLANKTON RECORDS: METHODS OF ANALYSIS, 1950-1959. Bulletins of Marine Ecology (formerly Hull Bulletins of Marine Ecology), Vol. V, No. 41, May, 1960, pp. 51-64.

There is a brief description of the methods of the routine analysis of Continuous Plankton Recorder collections.

The numbers of the zooplankton organisms present in the samples have been estimated within the limits of contiguous categories, successive categories increasing in size fairly rapidly. It was found that means and standard deviations calculated using these categorized counts provide reasonable estimates of the population values.

A new method of estimating the abundance of phytoplankton has been used since the beginning of 1958. The number of times each species is observed during a search, in which 20 microscope fields are examined, is used to estimate the abundance of the species.

The effect of a logarithmic transformation of the sample data on estimates of means and standard deviations is described.

The results are presented of an experiment aimed

at finding out whether the members of the team of workers made persistent errors during analysis. A few such errors were detected but with one possible exception none of them were considered to be very serious.

It is concluded that the various approximations used in routine analysis do not handicap the mathematical treatment of the Recorder collections taken at monthly intervals from an area of about half a million square miles of sea. (Auth. summ.)

4077. Rucker, R. R., W. T. Yasutake, and H. Wolf. 1961. TROUT HEPATOMA--A PRELIMINARY REPORT. Progressive Fish-Culturist, Vol. 34, No. 1, pp. 3-7.

A hepatoma of rainbow trout (Salmo gairdneri) and cutthroat trout (S. clarki) is described. Its etiology is thought to be associated with nutrition. (Auth. abst.)

4078. Larsen, Howard N., and S. F. Snieszko. 1961. COMPARISON OF VARIOUS METHODS OF DETERMINATION OF HEMOGLOBIN IN TROUT BLOOD. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 8-17.

Iron determination, by the Wong method with the Hainline modification, was used as a standard evaluation for hemoglobin determination in trout blood. Of the 3 spectrophotometric methods of hemoglobin determination tested (the acid hematin, cyanmethemoglobin, and oxyhemoglobin methods), the cyanmethemoglobin and oxyhemoglobin methods gave the most accurate results. The cyanmethemoglobin method is the method of choice, at present, because reagents are stable and standards can easily be secured. The acid hematin method is the least satisfactory because of suspended cell nuclei. (Auth. abst.)

4079. Lambou, Victor W. 1961. UTILIZATION OF MACROCRUSTACEANS FOR FOOD BY FRESHWATER FISHES IN LOUISIANA AND ITS EFFECTS ON THE DETERMINATION OF PREDATOR-PREY RELATIONS. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 18-25.

Usually it is not possible to sample crustaceans by rotenone poisoning; therefore, if macrocrustaceans are important in the diet of large predaceous fishes, predator-prey ratios determined by rotenone poisoning will be biased. Stomachs of alligator gar, spotted gar, yellow bass, largemouth bass, spotted bass, blue catfish, and channel catfish were examined to determine the utilization of macrocrustaceans for forage. Macrocrustaceans were important in the diet of some of the large predaceous fishes in some fish populations in Louisiana. There was a considerable difference in the occurrence of swamp crayfish in the diet of largemouth bass in The Flats, a backwater lake, during 1958 and 1959. During normal years largemouth bass in backwater habitats similar to The Flats apparently depend largely on swamp crayfish for forage. During 1959 a drastic reduction in the abundance of swamp crayfish forced largemouth bass in The Flats to turn to alternate foods, and available forage was less abundant. (Auth. abst.)

4080. Boccardy, Joseph A., and Edwin L. Cooper. 1961. RESILIENCE OF A FISH POPULATION IN A STREAM IN PENNSYLVANIA. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 26-29.

Observations made during 1958 on a stream chemically reclaimed during the previous fall indicated extensive repopulation of the waters by undesired fish. An additional chemical treatment revealed the presence of all species that were present at the time of the first reclamation, with little change in species composition of the population. (Auth. abst.)

4081. Weaver, A. J., and E. A. Friedrichsen. 1961. DIRECT TRANSFER OF RAINBOW TROUT SWIM-UP FRY TO PRODUCTION RACEWAYS. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 30-33.

Substantial reductions in hatchery construction costs would result if troughs and tanks could be eliminated by transferring fry directly from incubators to raceways. This procedure was tested at two California hatcheries in 1958 and 1959. Survival, growth, and general condition of the fish were excellent in the second test at each hatchery. Results approached those ordinarily obtained with troughs and tanks. (Auth. abst.)

4082. Bouchard, Loyal G., and Chester R. Mattson. 1961. IMMERSION STAINING AS A METHOD OF MARKING SMALL SALMON. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 34-40.

A method of staining young salmon for short-term mark-and-recover experiments was developed in 1958 in Alaska. The most satisfactory results were obtained with an aqueous Neutral Red dye solution at a concentration of 1:300, 000 and an immersion period of 7 hours. The coloration produced, depending on the species of salmon stained, ranged from a light to a medium red. Color retention was satisfactory for 72 hours, and mortality rates were less than with salmon marked by the fin-clip method. (Auth. abst.)

4083. Deacon, James E. 1961. A STAINING METHOD FOR MARKING LARGE NUMBERS OF SMALL FISH. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 41-42.

As many as 1, 500 fish were marked simultaneously by placing them in a dilute solution (1:5, 000 to 1:20, 000) of Bismark Brown Y for 3 hours. In the laboratory, color remained recognizable for two weeks. The method is designed for short-term population studies of small fish, where recognition of individuals is unimportant. (Auth. abst.)

4084. Tang, Yun-an. 1961. THE USE OF SAPONIN TO CONTROL PREDACEOUS FISHES IN SHRIMP PONDS. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 43-45.

Laboratory bioassay of the effect of saponin extracted from the seeds of Camellia on fish and

shrimps revealed that the resistance of shrimps to this toxicant was 50 times higher than that of fish. Experiments in ponds showed that the concentrations of saponin ranging from 2.5 to 10.0 ppm in the form of either powdered alcoholic extract or the seed-cake per se successfully killed all fishes, without harm to the shrimps inhabiting the same ponds. (Auth. abst.)

4085. Allison, Leonard N. 1961. THE EFFECT OF TRICAINE METHANESULFONATE (M.S. 222) ON THE MOTILITY OF BROOK TROUT SPERM. Progressive Fish-Culturist, Vol. 23, No. 1, pp. 46-47.

Tricaine Methanesulfonate (M.S. 222) was used in the fall of 1957 to anesthetize brood-stock lake trout at the Marquette (Michigan) Fish Hatchery and brook and brown trout at the Grayling Hatchery during spawn-taking operations. At both stations the anesthetized fish were rinsed in fresh water to remove all traces of the chemical before spawn-taking. An unusually high mortality of the eggs ensued at Marquette, where gloves were used in handling the fish; but a good hatch resulted at Grayling, where no gloves were used. Experiments to check the effect of various dilutions of M.S. 222 on spermatozoa of brook trout were made. In the presence of M.S. 222, spermatozoa remained motile for less than 10 seconds at concentrations of 18.9, 37.7, and 75.5 ppm, and for more than 10 seconds in four out of seven tests at concentrations of less than 18.9 ppm. In one test with urethane at a concentration of 2,995 ppm (2 oz. per 5 gal. of water), spermatozoa remained motile for less than 10 seconds. (Auth. abst.)

4086. Klust, Gerhard, and Hans Mann. 1960. UNTERSUCHUNGEN UBER DEN EINFLUB DES GELEGEBEKAMPFUNGSMITTELS "NATA" AUF DEN ABBAU DER ZELLULOSE. Archiv Fur Fischereiwissenschaft, Vol. XI, No. 2, pp. 151-158.

The preparation "Nata" is used in pond farms for extinguishing undesired hard littoral plants, in particular Carex, Phagmites and Scirpus. The exuberantly grown plants in the littoral zone are destroyed and the pond area thus gained will produce an increased fishing yield.

As shown by laboratory experiments with test tubes and in aquariums, Nata does not directly accelerate the decay of cellulosis, but it prepares the littoral plants for rotting. (Auth. summ.)

4087. Oliva, Ota. 1959. CONTRIBUTION TO THE QUESTION OF THE PROBLEM CROP OF FISHES IN NATURAL WATERS AND METHODS OF ITS ESTIMATION. (JESTE K OTAZCE MNOZSTVI RYB PRIROZENYCH NADRZICH A METODICE JEHO ODHADU.) Vestnik Ceskoslovenske Spolecnosti Zoologicke, Vol. XXIII, No. 3, pp. 280-288.

In the years 1951-1955 several similar experiments were performed in the inundation area of the river Labe in Middle Bohemia. In the pool "Cerna tun", water surface area 230 m^2, m about 1000 carps (Cyprinus carpio) were estimated (0, 95 confidence limits: about 826, 1261), calculated per hectar. In the second pool, "Velka Arazimova", water surface area 382 m^2, 2330 specimens of carps per hectar (0, 95 confidence limits: 1677, 3770), were estimated. In the third pool, called "Karasi tun", water surface area 402 m-., an extremely rich population of Crucian carps (Carassius carassius) was found. Population estimation, P = 109 300 specimens (ha, 0, 95 confidence limits: 75 600, 199 200 specimens). In the pond of the village Wykan near the town Cesky Brod in Central Bohemia, water surface area 4200 m^2., about 216 specimens of carps per hectar were estimated (0, 95 confidence limits: 152, 228). In the fifth locality, the backwater "Prochazkova tun", water surface area 1460 m^2., about 987 specimens per hectar of the Common Northern Bullhead (Ameiurus nebulosus) were estimated (0, 95 confidence limits: 814, 1255). And lastly in the brook "Rymola" I performed some experiments with the estimation of the fish populations by means of electric shocker. The stream was divided into several sections of 75 m in length. In every section the nets hindered the upstream and downstream migration of fishes during the experiment. We tried two times in each section to shock all fishes present here at the moment of estimation, and after this action, all fishes captured were marked by fin clipping and planted again into the stream. But the dividing nets between the sections were not removed. After one hour we began again with estimation and we collected not only all marked fishes, but also a considerable number of unmarked ones, which were not shocked during the first shocking operation described. I found after this revision of ability of the electric shocker used in the first section beside 20% marked fishes, another 60% of unmarked ones. In the second section of the brook only about 1 - 2 m. wide, 43% marked fishes were captured again, in addition to 14% unmarked ones. In the third section 30% marked fishes were discovered, 82% of both marked and planted ones newly collected. Totally 31% marked and 52% unmarked individuals were captured. In the first section about 8160 fishes per hectar were found, in the second one about 930 specimens per hectar, in the third one 1110 specimens per hectar, in the fourth one 2700 specimens per hectar, in the fifth one about 1980 specimens per hectar. The total fish biomass is very high; some fish species are not brook inhabitants, they immigrated from the river Labe.

The results obtained show that in all pools and ponds examined the fish population reached both high number and considerable weight. When we estimate the average weight of one carp in the pool "Cerna tun" about 250 gram. the total biomass of carps weighs about 250 kg. per hectar (0, 95 confidence limits: 207, 315 kg. /hectar). I do not include in this weight the weight of other fish species, inhabiting together with carps the pool. In the pool "Velka Arazimova" the total weight of carps (when again the average weight of one specimen is 250 gram) was estimated 582 kg. /hectar, confidence limits 418 - 917 kg. / hectar. I do not include again the other fish species found. In the pool, called "Karasi tun", 109 300 specimens of crucian carps (Carassius carassius) were estimated (75 600, 199 200 specimens/hectar). The weight of one fish being 10 gram only, the total biomass weighs about 1093 kg. /hectar, 0, 95 confidence

limits being 756, 1922 kg. /hectar. In the backwater "Prochazkova tun" when only the weight of the Northern Brown Bullheads (Ameiurus nebulosus) is considered, (estimating the average weight of one specimen 100 gram), the total weight reaches up to 696 kg. /hectar, 0.95 confidence limits 557, 859 kg/ hectar. According to our experiences with the composition of fish population in a similar backwater in its neighbourhood it is evident that this species is not predominating in this pool. Lastly, a very high number of fish was found in the brook "Vymola."

The pools and backwater of the inundation area of the river Labe in Middle Bohemia are not without fish, as the sporting fishermen have always declared, but they are evidently overfished, mostly by cyprinids. It is recommended to try to hinder further increase of cyprinids by means of intensive netting and seining operations and by planting and protection of pikes. (Auth. summ.)

4088. Lillelund, Kurt. 1960. I. DIE HYDROGRAPHIE DES SCHLENDORFER BINNENSEES. Zeitschrift Fur Fischerei Und Deren Hilfswissenschaften, Vol. IX, Nos. 3, 4, pp. 291-320.

For the brackish water lake, the morphology of the delta and its hydrography have changed greatly during the last 80 years. The hydrographic changes are reflected in an increasing leaching as well as silting and flattening of the water. Moreover, the investigations in question have shown that considerable changes of the hydrographic conditions may even occur within three years. (Auth. summ.)

4089. Ivlev, V. S. 1960. BESTIMMUNGSMETHODE DER VON DEM WACHSENDEN FISCH AUSGENUTZTEN FUTTERMENGEN. Zeitschrift Fur Fischerei Und Deren Hilfswissenschaften, Vol. IX, Nos. 3, 4, pp. 281-289.

The calculation of food utilized by fish during growth represents an important task, on the solution of which many theoretical and practical questions are dependent. Though numerous methods of determining the food requirement have become known, they all require special and time-consuming experiments.

The systematic evaluation of the comprehensive material obtained during the last years enabled the author to establish some general regularities, by the application of which the exact determination of the food quantity utilized by fish and the marking of losses caused by metabolism were made possible. The present paper describes the corresponding method in two variants by the example of young salmonidae. (The equations applied by the author proved to be absolutely suitable salmonidae.) The equations applied by the author proved to be absolutely suitable for the purposes of practical fish breeding. The main advantage of this method is its simplicity and that no special experiments will be necessary. Yet one correction is to be made resulting in connection with the significance of the "active" metabolism in that the calculations are based on the values of the so-called "standard metabolism" which were obtained from fish living practically motionless; under natural living conditions fish move however more or less actively increasing thus the metabolism. It is to be hoped that in most cases a standard value can be found for this correction. (Auth. summ.)

4090. Rehackova, Vera. 1959. HYDROBIOLOGY OF THE KLICAVA WATER BASIN. (HYDROBIOLOGIE UDOLNI NADRZE NA KLICAVE.) Vestnik Ceskoslovenske Spolecnosti Zoologicke, Vol. XXIII, No. 4, pp. 328-346.

In 1954-1957 the biological conditions in the newly constructed water basin in the valley of the river Klicava near Zbecno were investigated with main respect to its productivity.

The colour of water in the basin was green-yellow to yellow-green. In the above-said period the transparency of water fluctuated between 2, 7-3, 5 m.

The amount of plankton organisms in the whole basin was ascertained by means of a so-called representative sample according to the line of contents.

The maximum development of plankton organisms could be observed twice a year--in April and from June to August.

The total number of plankton organisms increased in the period from 1955 - 1957. With respect to the higher number of specimens by the same specific composition it can be assumed that the productivity of the basin, i.e. amount of the organic mass produced in a year, has been increased.

Two fundamental biogenic elements phosphorus and nitrogen were examined in the samples of water taken from the basin surface, in form of total phosphorus and organic and ammoniacal nitrogen. The relation of organisms in the basin to the changes of contents of these elements was investigated.

Amount of the total phosphorus varies during the year, reaching the maximum in the winter months and minimum in summer. Thus, the summer maximum of phytoplankton falls into the period of minimum total phosphorus.

The contents of organic and ammoniacal nitrogen varies quite insignificantly during the year. Distinct maxima and minima do not appear.

At present it is impossible to determine the relation between the amount of both biogenic elements--phosphorus and nitrogen--and the amount of organisms. The development of plankton organisms will be probably strongly influenced also by biotic agents, e.g. the fish population. (Auth. summ.)

4091. Fry, Donald H., Jr. 1961. KING SALMON SPAWNING STOCKS OF THE CALIFORNIA CENTRAL VALLEY, 1940-1959. California Fish and Game, Vol. 47, No. 1, pp. 55-71.

Methods used have included fish ladder counts, fish weir counts, estimates of spawners, tag and recovery calculations, and (more recently) redd counts from the air. Many counts have been incomplete because counting weirs could not be kept fish-tight or were washed out by floods. In the early years most help was relatively inexperienced and gave esti-

mates which were too low. Tag and recovery calculations gave satisfactory results on the American and Stanislaus rivers, but results on the upper Sacramento River have been much less satisfactory. Aerial redd counts seem to have possibilities but have not yet been standardized against fish ladder counts.

Because of a lack of manpower the earlier counts covered only limited areas; not until 1953 was an estimate made which covered the fall run of the entire Central Valley. Counts of the much smaller spring run have never covered the entire valley.

The king salmon is the only salmon of any importance in the Central Valley. Some silver salmon have recently been introduced in the Sacramento River, and some kokanee above Shasta Dam. King salmon are of three types: Fall run which enter in the fall or winter and spawn soon after arrival; spring run which enter in the spring but do not spawn until fall; and winter run which enter in the late winter and spawn in early summer. Fall run fish are kept separate in the counts; they are found in fewer stream and are much less numerous in total. Winter run fish are the least numerous and are confined to the upper Sacramento Valley. They are included with the fall run fish. The largest spring run may have been that of the San Joaquin River; it has been eliminated by the total diversion of the river since construction of Friant Dam and its attendant canal systems.

The largest fall run has been that of the Sacramento River which since 1953 has been estimated to have runs as high as 408,000 (1953) and as low as 68,000 (1957). In the same period, the entire Central Valley has ranged from 597,000(1953) down to 117,000 (1957).

The spring run of the San Joaquin was 56,000 in 1945 but has been at or near zero since 1948. A complete estimate of the Sacramento spring run was first made in 1946 and last made in 1956. During that period it has varied from 26,000 (1946) down to 5,000 (1951). (Auth. summ.)

4092. Craig, William L., and Joseph J. Graham. 1961. REPORT ON A CO-OPERATIVE, PRE-SEASON SURVEY OF THE FISHING GROUNDS FOR ALBACORE (THUNNUS GERMO) IN THE EASTERN NORTH PACIFIC, 1959. California Fish and Game, Vol. 47, No. 1, pp. 73-85.

Fishing gear consisted of feather and bone jigs, longlines and gill nets. Trolling north of Lat. 32° N. produced the only catches of albacore. Of 314 caught trolling, 207 were tagged and released. Fourteen gill net sets and nine longline sets caught no albacore. These two types of gear did produce small catches of bigeye tuna, skipjack, Pacific bonito, pomfrets, dolphin, blue shark, bonito shark and hammerhead shark. The predominant size group of albacore caught was from approximately 11 to 14 pounds. Offshore sea surface temperatures ranged from about 57 to 65 degrees F. Albacore occurrences were limited to a range between 58.6 and 61.7 degrees F.

4093. Needham, Paul R. 1961. OBSERVATIONS ON THE NATURAL SPAWNING OF EASTERN BROOK TROUT. California Fish and Game, Vol. 47, No. 1, pp. 27-40.

Spawning behavior of a single pair of eastern brook trout, Salvelinus fontinalis, was studied in Sagehen Creek, California, from an underwater observation tank.

Two artificial spawning beds were constructed of gravel beside the two downstream windows of the tank. These proved most successful - the fish moving on to them promptly after they were installed. Washed gravel of walnut size and smaller was used.

The pair observed was quite territorial, driving away all invaders aggressively from their nest area. No color changes were observed in the trout while assuming threat postures.

Brown trout, Salmo trutta, stocked in the tank pool, spawned only at night, while the brook trout appeared to spawn both day and night. Rainbow trout, Salmo gairdnerii, did not molest the spawners at any time, nor were they observed to attempt to eat eggs deposited in the redd.

Spawning activities of the female consisted of searching for a suitable nest site, nest cutting, testing of nest site by "anchoring" or "crouching," actually spawning, and covering eggs. During the latter process the female went through a kind of a "post-nuptial" dance in which she performed a weaving, undulating movement using the ventral portions of anal and caudal fins to gently push gravel into the pit over the eggs. After actually spawning once, she immediately began to cover the eggs.

The activities of the male were largely related to aggressively fighting off all intruders into the nest area and in sharing in the spawning act. He did not share in the cutting of the nest.

The female, when ready to spawn, produced an appropriate signal movement when her anal fin was in the deepest part of the pit. The male swiftly took his place beside her; both opened their mouths wide and trembled while eggs and milt were emitted simultaneously. About one second was required for each of the two acts observed.

The peak of the spawning period in Sagehen Creek occurred between October 1 and October 15--when daily, minimum water temperatures ranged between 37 and 44 degrees F. Volume of water flow varied from 1.7 to 1.9 cubic feet per second over the same period. (Auth. summ.)

4094. McCammon, George W., and Don A. LaFaunce. 1961. MORTALITY RATES AND MOVEMENT IN THE CHANNEL CATFISH POPULATION OF THE SACRAMENTO VALLEY. California Fish and Game, Vol. 47, No. 1, pp. 5-23.

Disk-dangler tags were attached to 797 channel catfish during April and May, 1955. The fish were released in approximately equal numbers at four locations. They ranged from 6.8 to 22.1 inches in fork length, with a mean length of 12.1 inches.

Anglers voluntarily returned 228 tags during the following four years. Annual recoveries were: first year, 146; second year, 54; third year, 20; and

fourth year, 8.

The locations of angler recaptures indicated that the population is essentially restricted to a relatively small area, circumscribed by Colusa on the Sacramento River, Marysville on the Feather River, and the confluence of the Sacramento and Feather rivers. Movements within this area were extensive; however, only 13 percent of the total recoveries were recorded from outside the area. The tagged catfish demonstrated a definite propensity for migration into Sutter Bypass, a flood control channel with permanent sloughs that traverses the fishery area.

Estimates of survival and mortality were based on concepts and procedures presented by Ricker (1958). These estimates, corrected for an assumed rate of nonreporting of tag recoveries by anglers of 40 percent and for variations in vulnerability were:

s = mean survival - - - - - - - - - - - - = 0.440
a = mean annual total mortality - - - - - = 0.560
i = instantaneous mortality rate - - - - -= 0.821
p = instantaneous fishing mortality rate- -= 0.445
q = instantaneous natural mortality rate - = 0.376
u = annual expectation of deaths from fishing - - - - - - - - - - - - = 0.304
v = annual expectation of deaths from natural causes - - - - - - - - - = 0.256
m = annual conditional fishing rate - - - -= 0.359
n = annual conditional natural mortality rate - - - - - - - - - - - - - -= 0.314

The current rate of fishing appears to be providing a sustained yield in weight that is near maximum. (Auth. summ.)

4095. Fryer, Geoffrey. 1960. SOME CONTROVERSIAL ASPECTS OF SPECIATION OF AFRICAN CICHLID FISHES. Proceedings of the Zoological Society of London, Vol. 135, Part 4, pp. 569-578.

A clear distinction must be made between the intralacustrine speciation shown by some groups of African cichlid fishes and the simple specific proliferation shown by others. The former phenomenon is exhibited by several genera but hardly at all by the genus Tilapia.

Inshore dwelling habits and an algal diet have not had restrictive effects on speciation. In fact it is among inshore species that speciation has been most active.

While, partially by exploiting their small size, genera which have given rise to the endemic species flocks of the great lakes have become specialized for the exploitation of specific niches, the species of Tilapia have usually remained large and unspecialized and therefore capable of existing in a variety of environments.

Further consideration of the effects of predation supports the idea that it has accelerated rather than retarded the process of speciation.

If certain conditions are fulfilled, closely related species can co-exist throughout life in one habitat, eat the same kind of food and breed in close proximity. (Auth. abst.)

4096. Edmondson, W. T. 1960. REPRODUCTIVE RATES OF ROTIFERS IN NATURAL POPULATIONS. Memorie Dell'Istituto Italiano Di Idrobiologia Dott. Marco De Marchi, Vol. XII, pp. 21-74.

It is shown that the ratio eggs: females in a population is proportional to the rate at which eggs are laid. This birth rate can be calculated if the duration of development of the eggs is known, according to the relation $B = E/D$, where B is the daily population birth rate, E is the ratio eggs: females, and D is the duration of development in days. The corresponding instantaneous birth rate is given by $b' = \ln (B + 1)$.

The difference between the birth rate and the instantaneous rate of change of the population size, r', gives the death rate, d'.

Data are given on the duration of development of several species of planktonic rotifers at different temperatures.

A detailed discussion is presented of the limitations of the present data and of the information required to extend the usefulness of the method which is potentially applicable to many different kinds of animals. (From auth. summ.)

4097. Tonolli, Vittorio. 1960. DISUNIFORMITA SPAZIALE DELLE VICENDE TERMICHE NEL LAGO MAGGIORE. Memorie Dell'Istituto Italiano Di Idrobiologia Dott. Marco De Marchi, Vol. XII, pp. 81-119.

The thermal structure of the first 50 metres of the Lago Maggiore, in northern Italy, has been analyzed in the course of a whole year (14 cruises) from data obtained with a Wallace and Tiernan bathythermograph at 12 stations.

The isopleths show clearly a systematic sinking of the isothermal layers from the northern towards the southern end of the lake, which can be attributed to the large inflow of water from the Swiss rivers and to the gradual rise of the lake bottom towards the southern extremity, from which the outlet flows.

A special state of affairs which disturbs this general thermal structure is found, at least in certain strata, at stations 4 and 5 owing to the inflow of warm water from the epilimnion of lake Lugano through the River Tresa, at station 8 from the proximity of the cold River Toce, and at station 10 where an up-welling of waters - due to the conformation of the lake floor and the probable existence of a bottom current - seems to be more or less constant.

This general inclination of the isothermal layers towards the south results also in a varying thickness of the epilimnic layer, always considerable at the southern stations, but very often hardly perceptible, or absent, at northern ones.

All these circumstances give rise to particular and even very diverse seasonal thermal vicissitudes at the separate stations, resulting in different annual thermal budgets in the various regions of the lake.

An underestimate of a possible lack of uniformity in the thermal structure of large lacustrine environments may result in a highly arbitrary extrapolation to the whole lake of biological phenomena only known in their magnitude at one or at a very limited number

of points in the basin. (Auth. summ.)

4098. Vollenweider, Richard A. 1960. BEITRAGE ZUR KENNTNIS OPTISCHER EIGENSCHAFTEN DER GEWASSER UND PRIMARPRODUKTION. Memorie Dell'Istituto Italiano Di Idrobiologia Dott. Marco De Marchi, Vol. XII, pp. 201-244.

The relationship between photosynthesis and optical properties of the euphotic layer has been analysed in investigations performed in lakes and other waters of different regions which represent a wide range of trophic and optical types. Primary production was studied "in situ" with C^{14}-short-run experiments (4-6 hrs).

In agreement with general assumptions, the photosynthetic rates of natural phytoplankton communities in strata below the layer of optimal activity were found to be controlled primarily by the total energy flux of the photosynthetic active spectrum (380-700 mμ), regardless of its specific spectral composition.

Range and limits of Secchi disk readings with regard to their value as subsidiary information on optical properties and primary production are discussed.

In highly productive lakes Secchi disk readings are related rather definitely to primary production, but the correlation decreases with increasing mean transparency. Under various conditions Secchi disk readings may be correlated to the ratio between production rates per unit surface and per unit volume ($\Sigma a/a_{opt}$).

The relationship between assimilation rates per unit surface (Σa) and per unit volume (a_{opt}) and approximative photosynthetic depths can be represented in a log-log-diagram, in which every lake occupies a certain band within a limited area, depending upon its optical properties. (From auth. summ.)

4099. Povoledo, Domenico. 1960. NATURA CONCENTRAZIONE E METODI DI STUDIO DI ALCUNI COMPOSTI NINIDRIN POSITIVI PRESENTI NELL' ACQUA DI ALCUNI LAGHI DELLA ITALIA SETTENTRIONALE. Memorie Dell'Istituto Italiano Di Idrobiologia Dott. Marco De Marchi, Vol. XII, pp. 289-334.

The nitrogenous organic compounds of low molecular weight present in solution in the water of Lakes Maggiore, Varese and Monate can be conveniently adsorbed on polystyrene sulphonate resins; in this way their analysis is rendered more rapid and easier. Two methods based on this principle are described, the first of which allows of the study in the laboratory of considerable volumes of water, and the second permits the adsorption of the substances under investigation directly in the lake. Analytical methods (chromatographic and ionophoretic) employed after ammoniacal elution of the resins are likewise described in detail.

A modification of a colorimetric method using ninhydrin is described, which allows of a semi-quantitative estimation of the total amino nitrogen present in the water of a lake. The precision and the specificity for amino acids are discussed, taking into account the possible interference by other compounds.

The biological importance of the findings is emphasized, as regards their qualitative value and in the light of the peculiar position which the substances found apparently occupy in the nitrogen cycle of the lakes, particularly as possible nutritive substances for algae, bacteria and protozoa in inland waters. (From auth. summ.)

4100. Muncy, Robert J. 1960. A STUDY OF THE COMPARATIVE EFFICIENCY BETWEEN NYLON AND LINEN GILLNETS. Chesapeake Science, Vol. 1, No. 2, pp. 96-102.

Field tests were conducted during the spring of 1959 to compare the differences in the catches of soft-rayed fishes by synthetic (nylon) fiber and natural (linen) fiber gillnets. Test nets were matched as closely as possible from commercial net sources and each section was located randomly as to sequence of mesh size and material.

American shad (Alosa sapidissima), glut herring (Alosa aestivalis), and alewife herring (Alosa pseudoharengus were the only species caught in sufficient numbers for comparisons between nets of different fibers. Analysis of the catches of American shad revealed differences in the numbers, length-frequency and length-weight of fish from nylon and linen gillnets.

Nylon anchor gillnets caught twice as many American shad as were caught in linen anchor gillnets of the same length and mesh sizes. Also, male American shad taken from nylon nets were heavier than those taken from linen nets. Although statistical comparisons were not possible with the small number of herring caught in anchor gillnets, the greater numbers of fish were taken in nylon nets. (Auth. abst.)

4101. Mansueti, Romeo J. 1960. SELECTION OF BODY SITE FOR SCALE SAMPLES IN THE WHITE PERCH, ROCCUS AMERICANUS, Chesapeake Science, Vol. 1, No. 2, pp. 103-109.

Scales from 13 different areas of the body of white perch, Roccus americanus, were studied to ascertain the extent of variability in the calculated standard length at the formation of the first annulus. The objective was to determine the area from which scales most representative of all the areas could be sampled for age and growth studies. Calculated lengths from each area in 10 specimens ranging from 75 to 143 mm standard length from age groups I to III were compared with the average for all areas, and the one with the least deviation from the mean was considered suitable for age, growth and tagging studies. Minimum average differences were obtained from scales taken from the side of the body under the posterior two-thirds of the dorsal fins, both above and below the lateral line. Area 9 above the lateral line and between the spinous and soft dorsal fin was selected as the sample site in a study of the white perch population of the Patuxent River, Maryland. (Auth. abst.)

4102. Mansueti, Romeo J. 1960. AN UNUSUALLY LARGE PUGHEADED STRIPED BASS, ROCCUS SAXATILIS, FROM CHESAPEAKE BAY, MARYLAND.

Chesapeake Science, Vol. 1, No. 2, pp. 111-113.

A deformed striped bass with typical pugheaded features, weighing 5 1/4 pounds and measuring 19.3 inches fork length, is described and compared with a normal specimen. A six-year old male, it apparently exceeds all previous size records for pugheaded striped bass. The specimen possesses an acutely steep forehead and pushed-in snout, exophthalmic eyes, enlarged and broadened mandible, and incomplete closure of jaws. It was in good condition, although size attained at each age was less than that for normal striped bass at the same age. The literature is reviewed in some detail and factors that induce pugheadedness, believed due to environment and heredity, and not mechanical injury, are discussed briefly. (Auth. abst.)

4103. Taylor, Malcolm, and Romeo J. Mansueti. 1960. SOUNDS PRODUCED BY VERY YOUNG CREVALLE JACK, CARANX HIPPOS, FROM THE MARYLAND SEASIDE. Chesapeake Science, Vol. 1, No. 2, pp. 115-116.

Three very young crevalle jack, ranging from 38 to 41 mm total length, emitted a burst of rapid, short, rasping croaks upon being landed in a beach seine out of the ocean surf. Dissection revealed well-developed upper and lower pharyngeal teeth indicating that sounds were produced as in the adults. (Auth. abst.)

4104. Mansueti, Romeo J. 1960. OCCURRENCE OF THE ROUGH SCAD, TRACHURUS LATHAMI, IN CHESAPEAKE BAY, MARYLAND. Chesapeake Science, Vol. 1, No. 2, pp. 117-118.

The rough scad, Trachurus lathami Nichols, is recorded from the Maryland part of Chesapeake Bay for the first time. It was captured in a trawl towed at a depth of 60 feet on July 21, 1958 at a salinity of about 14 ppt. The specimen was 102 mm standard length, apparently from age group I based on scale examination, and somewhat smaller than average size. (Auth. abst.)

4105. Robinson, Paul F., Charles G. Wilber, and Joseph Hunn. 1960. ORGAN-BODY WEIGHT RELATIONSHIPS IN THE TOADFISH, OPSANUS TAU. Chesapeake Science, Vol. 1, No. 2, pp. 120-122.

The following organs from male and female specimens of Opsanus tau were weighed: heart, liver, spleen, gut, brain, eyes. Prediction equations for organ weight in terms of body weight were derived. Best correlation was found between weight of eyes and body weight. A hyperbolic relationship between total body weight and brain as percent of body weight was postulated. (Auth. abst.)

4106. Wilber, Charles G., and Paul F. Robinson. 1960. THE CORRELATION OF LENGTH, WEIGHT, AND GIRTH IN THE TOADFISH, OPSANUS TAU. Chesapeake Science, Vol. 1, No. 2, pp. 122-123.

Length, girth and weight were taken from a series of toadfish. Prediction equations for each variable in terms of another were derived. It was found that these various measurements correlate so highly with one another ($r = 0.97$) that they can be used interchangeably in making comparisons of various kinds. (Auth. abst.)

4107. Schwartz, Frank J. 1960. AN UNUSUAL WINTER SURVIVAL OF A YOUNG SPADEFISH, CHAETODIPTERUS FABER. Chesapeake Science, Vol. 1, No. 2, pp. 123-124.

A young-of-the-year (60.8 mm standard length, 77.7 mm total length) spadefish, Chaetodipterus faber, was found to survive low winter temperatures in shallow tidewater a few feet from the Chesapeake Bay, Calvert County, Maryland. It was discovered in a temporary shore pool at a water temperature of 7.5°C (44.5°F) with a salinity of 16 ppt. in December, 1959. (Auth. abst.)

4108. Schwartz, Frank J. 1960. COMMENTS ON THE SMOOTH DOGFISH, MUSTELUS CANIS, FROM CHESAPEAKE BAY, MARYLAND. Chesapeake Science, Vol. 1, No. 2, pp. 124-125.

Five recent distributional records of the smooth dogfish, Mustelus canis, are presented from widely separated localities in Chesapeake Bay, Maryland. (Auth. abst.)

4109. Vibert, Richard. 1959. DISPOSITIF VERTICAL D'INCUBATION EN MASSE. Bulletin Francais de Pisciculture No. 192, pp. 104-115.

In order to save space, water, and money in trout or salmon hatchery operations, several vertical devices were built in the past, known as vertical incubators or drip incubators. In these devices eggs lie on trays or in baskets set one above the other. In this new vertical apparatus eight or ten liters or eggs are put together in commercial plastic pails, with a flow of water from the bottom. These pails are stocked in the dark in a closed hatching chest. A very simple device changes the supply of water twice a week with a 1/200 000 malachite green dilution. No fungus, very light mortalities and no picking of dead eggs until a few days before hatching when the eggs are ready. Two levels of pails allow a production of one million brown trout eggs per square meter with a water supply of 20 liters by minute. A number of these very cheap vertical devices for mass hatching are used in State and private French hatcheries. (Auth. abst.)

4110. Edsall, Thomas A. 1960. AGE AND GROWTH OF THE WHITEFISH, COREGONUS CLUPEAFORMIS, OF MUNISING BAY, LAKE SUPERIOR. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 323-332.

This study is based on a sample of 415 whitefish collected in 1953 from an unexploited population in Munising Bay, Lake Superior. Gill-net and trawl catches had different length-frequency distributions and age compositions, but estimates of growth from the two catches were very similar. The body-scale relation is a straight line with an intercept of 1.5 inches. Weight of Munising Bay whitefish captured in June increased as the 3.17 power of the length. Growth in length and weight of Munising Bay whitefish was the slowest yet reported from Great Lakes waters. Munising

Bay whitefish required nearly 8 years to reach a length of 10 inches and a full 13 years to reach 15 inches. Slightly more than 8 years were required to reach a weight of 8 ounces and a little less than 14 years to reach 1 pound. The sex ratio of the Munising Bay whitefish exhibited no systematic change with an increase in age. The entire sample for which ages were determined contained 52 percent males. Munising Bay whitefish matured at much shorter lengths but at a greater age than reported for other Great Lakes whitefish populations. The smallest mature males were in the 11.5- to 11.9 inch length interval (age-group VII) and all males longer than 14.4 inches (age-group XII) were mature. The first mature females appeared at 12.0-12.4 inches (age-group X) and all females longer than 14.9 inches (age-group XII) were mature. The more rapidly growing individuals matured earlier than the slow-growing ones. (Auth. abst.)

4111. Turner, William R. 1960. STANDING CROPS OF FISHES IN KENTUCKY FARM PONDS. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 333-337.

Estimates of standing crops of fishes in 22 Kentucky farm ponds were made during the summers of 1956, 1957, and 1958. The studies were essentially limited to ponds containing populations of largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus), and/or green sunfish (Lepomis cyanellus). Prior to treatment with rotenone, fish were captured by seining, finclipped, and returned to the pond. The total standing crops were calculated from the percentages of fin-clipped fish recovered following the total eradication of each fish population. Standing crops of fish in the 22 ponds ranged from 73 to 770, and averaged 385 pounds per acre. Nine ponds contained balanced, while 13 contained unbalanced fish populations. F/C ratios in the balanced populations ranged from 1.6 to 8.0, and averaged 4.6 while in the unbalanced populations they ranged from 4.1 to 37.7, and averaged 16.6. In the nine ponds containing balanced populations there was an average standing crop of 282 pounds of fish per acre, and 48 percent (130 pounds per acre) of that weight was composed of harvestable-sized fish. In the 13 ponds containing unbalanced fish populations there was an average standing crop of 456 pounds per acre, of which only 15 percent (70 pounds per acre) was composed of harvestable-sized fish. There was a relatively high positive correlation between the size of the standing crops and the total alkalinities in the ponds ($r = 0.67$). There was a positive correlation between the size of the standing crops and the amounts of potassium ($r = 0.44$ and phosphorus ($r = 0.72$) present in the soils of the watersheds. (Auth. abst.)

4112. Christmas, J. Y., and Gordon Gunter. 1960. DISTRIBUTION OF MENHADEN, GENUS BREVOORTIA, IN THE GULF OF MEXICO. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 338-343.

There are three menhaden in the Gulf of Mexico, Brevoortia patronus ranges around the northern Gulf from Brazos Santiago, Texas, to Tampa Bay, Florida, and supports a large commercial fishery centered in the area of greatest abundance, the Louisiana coast. The fish grows up in estuarine areas and ranges into fresh water at smaller sizes. It ranges into pure sea water and as far offshore as 25 miles. The greatest depth at which it has been taken is 20 fathoms. Brevoortia gunteri and B. smithi are fine-scaled species that live in the western and eastern Gulf, respectively. (The latter species is also found in the Atlantic.) Both enter fresh waters at small sizes. The greatest depth at which they have been taken is 8 fathoms, and the offshore salinity limit is unknown. The known range of B. gunteri extends from Chandeleur Sound, east of the Mississippi River, around the shores of the western Gulf to Campeche, Mexico. It is not often caught in the eastern part of its range, and the greatest abundance seems to be in the western Gulf. The known range of B. smithi is extended from Cedar Keys, Florida, to Chandeleur Sound, Louisiana, where all three species of Gulf menhaden come together. B. smithi ranges also southward to the Caloosahatchee River, Florida. Brevoortia gunteri and B. patronus have been recorded in the Laguna Madre of Texas at salinities of 60 per mille. Brevoortia gunteri and B. smithi apparently grow to considerably larger size than B. patronus, but they are much less abundant and are not important in the commercial fishery. (Auth. abst.)

4113. Hooper, Archie D., and Johnie H. Crance. 1960. USE OF ROTENONE IN RESTORING BALANCE TO OVERCROWDED FISH POPULATIONS IN ALABAMA LAKES. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 351-357.

Overcrowded sunfish populations have occurred in 5 of Alabama's 18 State-owned public fishing lakes. They have resulted from a combination of factors, including presence of undesirable fish species, infestation with a branched alga, fish kills, loss of fish over the spillway, and heavy fishing. These overcrowded populations were usually balanced by three to seven marginal, or a combination of marginal and sectional, treatments with rotenone applied usually during September and October. The annual average catch by anglers was 193.4 pounds per acre during the years that the five lakes contained balanced fish populations, and 132.7 pounds per acre during the years that the lakes contained overcrowded forage fish populations. Although these lakes contained overcrowded forage fish populations for varying periods of time, an annual average of 156 fishermen per acre caught 174.5 pounds of fish during the 5 to 8 years that the lakes were open to continuous public fishing. This high sustained harvest was attributed to prompt correction of unbalanced fish populations by partial poisoning with rotenone. (Auth. abst.)

4114. Neuhold, John M., and William F. Sigler. 1960. EFFECTS OF SODIUM FLUORIDE ON CARP

AND RAINBOW TROUT. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 358-370.

The symptoms of acute fluoride intoxication in carp and rainbow trout include lethargy, violent and erratic movement, and death where there is partial or complete muscle contraction. Excessive mucus production associated with an increase in mucous cells in the epithelium of the head region and the gills also occurs. Changes in the electrophoretic pattern of the serum proteins in carp blood are evident. There is an increase in the fluoride concentration of the bones and a hypertrophy of the ultimobranchial gland. Rainbow trout embryos display initial symptoms similar to adult fish, including lethargy, violent movement, and tetany. Rupturing of the chorion by the embryo is attributed to violent movement during the onset of intoxication. Lethal doses and the sensitivities of fish to the toxin are dependent on several variables including size of fish, temperature of medium, and calcium and chloride concentration of the medium. It was demonstrated that there is an uptake of fluoride in muscle tissue, cancellous bone, and skeletal bone, and that uptake was increased when there was a rise in the fluoride concentration of the medium. The uptake of fluoride by the bone was via a second-order reaction and is assumed to be an enzymatic process. Proliferation of mucous cells in the epithelium of the gills and the head region is postulated to be instrumental in the excretion of fluoride from the body, and is considered an effective defense mechanism against fluoride intoxication. Hypertrophy of the ultimobranchial gland is thought to result from a deficiency in calcium induced by the effects of fluorides. The uptake of fluoride by the bone is a defense mechanism against fluoride intoxication and is postulated to occur with the elimination of fluoride from body circulation. This fluoride forms a stable mineral complex. (Auth. abst.)

4115. Schumacher, Robert E., and Samuel Eddy. 1960. THE APPEARANCE OF PINK SALMON, ONCORHYNCHUS GORBUSCHA (WALBAUM), IN LAKE SUPERIOR. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 371-373.

Two salmonid fishes were caught in the fall of 1959 by two anglers in or just above the mouths of two Minnesota streams flowing into Lake Superior and were turned over to the Minnesota Department of Conservation. They were identified as pink salmon, Oncorhynchus gorbuscha (Walbaum), and have been deposited in the collections of the University of Minnesota. The only available facts are that two pink salmon, 2 years old, were caught by anglers in or near the mouths of two streams flowing into Lake Superior. The only probable origin seems to be indirectly from an escapement of pink salmon from the 1955 brood at the Port Arthur Hatchery in 1956. If this is the source, some of these salmon completed their life cycle in Lake Superior and spawned successfully in the fall of 1957. The survival and growth of salmon from eggs spawned in the fall of 1957 resulted in at least two males which reached maturity and were caught by anglers in 1959.

4116. Lux, Fred E. 1960. LENGTH SHRINKAGE OF YELLOWTAIL FLOUNDER BETWEEN LIVE AND LANDED CONDITION. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 373-374.

In fish-tagging experiments it is sometimes found that lengths of early recaptures are less than lengths recorded at time of tagging. This difference has been observed in marking experiments on yellowtail flounder, Limanda ferruginea, off the New England coast. Change in length was carefully examined in a recent marking experiment conducted in March 1959. At that time 2,100 yellowtail were tagged on fishing grounds off southern New England. In the two weeks following tagging, 99 of the fish were recaptured by commercial otter trawlers and given to Bureau of Commercial Fisheries personnel stationed at ports of landing. Mean change in length was about -1.2 percent. It was assumed that the shrinkage occurred between time of capture and time of landing. In normal commercial fishing operations the fish are stored in crushed ice in the vessel's fish hold during this period. To determine the amount of shrinkage the lengths of 72 live yellowtail from a catch of the Bureau of Commercial Fisheries research vessel Delaware were recorded and each fish was identified with a numbered tag. The fish were then placed in ice in the fish hold of the vessel to simulate holding conditions aboard a commercial fishing vessel. All fish were shorter at the second measurement. Mean change in length was about -1.5 percent. The length change appeared constant for the entire range of fish sizes. It seems likely that similar shrinkage occurs in other fish species. Knowledge of the amount of such shrinkage would be of value in determining growth from tagged fish. In addition, it would be useful in studies where length frequencies of live fish are obtained at sea and are combined with length frequencies of fish that have been stowed in ice in vessel holds for several days.

4117. Bonde, Thomas, and J. E. Maloney. 1960. FOOD HABITS OF BURBOT. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 75-76.

The primary food of the burbot in Lake Mille Lacs during the winter months is perch, with darters, cyprinids, and sculpins among the vertebrates and crayfish and mayfly larvae, among the invertebrates, as a secondary food. Since competition between the burbot and walleye undoubtedly exists and the burbot's role in the dynamics of certain lakes must be considered, its value both as a predator and a food source should be given further consideration.

4118. Schultz, Edward E. 1960. ESTABLISHMENT AND EARLY DISPERSAL OF A LOACH, MISGURNUS ANGUILLICANDATUS (CANTOR), IN MICHIGAN. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 376-377.

Treatment with rotenone and toxaphene of a private pond on Hy Meadow farm near Holly, Oakland

County, Michigan, in July 1958, by Wayne Tody and Bruce Vollmar of the Michigan Department of Conservation, revealed a large population of a small, unfamiliar, eel-like fish. Specimens were submitted to the Museum of Zoology of the University of Michigan where their identity as Oriental weatherfish (or the dojo), Misgurnus anguillicaudatus (Cantor) was confirmed by Dr. Reeve M. Bailey. In order to determine the extent of dispersal, 16 fish collections were taken in the Shiawassee River system. Dojos were collected at 5 of the 16 stations, indicating a continuous distribution throughout at least 10 miles of a section of the stream that passes through six lakes. The size range of the fish (1.2 to 7.1 inches, total length) proves that dojos reproduce successfully in the watershed. The fact that dojos were collected in both September 1958 and August 1959 verified their survival of the weather extremes in southern Michigan during this period.

4119. Roos, John F. 1960. PREDATION OF YOUNG COHO SALMON ON SOCKEYE SALMON FRY AT CHIGNIK, ALASKA. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 377-379.

The decline in sockeye runs has prompted investigation of factors causing mortality to young sockeye salmon during fresh-water residence. Investigations of Dolly Varden (Salvelinus malma) at Shignik (Roos, 1959) have shown that they are predators of juvenile sockeye salmon. Stomach analysis of coho fingerlings, collected during the summers of 1956, 1957 and 1959, has revealed that coho salmon also prey upon sockeye salmon fry. Coho salmon were collected with a beach seine from the two lakes during May, June, and July. The young coho salmon included two age groups, both of which fed on young sockeye salmon. It would therefore appear that each year class preys upon sockeye salmon for two seasons. Inspection of stomachs of sockeye fingerlings (age groups I and II) captured with the young coho revealed that they were feeding upon insects. It appears that young coho are also food competitors with sockeye salmon. These data indicate that young coho in the Chignik system prefer young sockeye salmon over sticklebacks as a source of food. All evidence gathered to date at Chignik suggests that coho salmon are more detrimental than beneficial to sockeye salmon.

4120. Brown, C. J. D., and Sidney M. Logan. 1960. AGE AND GROWTH OF FOUR SPECIES OF WARM-WATER GAME FISH FROM THREE MONTANA PONDS. Transactions of the American Fisheries Society, Vol. 89, No. 4, pp. 379-382.

These ponds lie adjacent to one another, are without inlets or outlets, and depend upon seepage for their water supply. The fish used in the age-and-growth study were randomly selected for size from several thousand specimens picked up after the ponds were treated with toxicants. The average calculated length at each annulus shows very slow growth in all three ponds. A useful size (10 inches) was not reached until the fifth year, and a weight of 1 pound was not achieved until the sixth or seventh year. The longest fish was 16.2 inches in total length and weighed 2.6 pounds. The heaviest fish was a female, 16.1 inches long and weighing 3.3 pounds. We found no record where largemouth bass grew as slowly as determined for Three Forks ponds. Bluegills, like largemouth bass, showed slow growth. They did not reach a total length of 5 inches until their fifth year. The largest bluegill recovered was a male 7.3 inches long from the Middle Pond which weighed 0.3 pound. Calculated total lengths of crappie show that it reached a useful size of 6 inches during the fifth summer. The largest specimen taken was 8.2 inches and weighed 0.27 pound and the oldest specimens had seven annuli and averaged 7.0 inches in total length. The average calculated total length of perch at the third annulus was 5.7 inches. The largest specimen taken was a female 11.2 inches long and weighing 0.75 pound, and the oldest specimens had six annuli and averaged 10.7 inches in total length.

4121. Strickland, J. D. H., and T. R. Parsons. 1960. A MANUAL OF SEA WATER ANALYSIS (WITH SPECIAL REFERENCE TO THE MORE COMMON MICRONUTRIENTS AND TO PARTICULATE ORGANIC MATERIAL). Bulletin No. 125, Fisheries Research Board of Canada, 185 pgs.

4122. Das, B. C. 1961. COMPARATIVE STUDY OF THE BLOOD BIOCHEMISTRY OF THREE SPECIES OF INDIAN CARP. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 1-5.

Samples of three species of Indian carp, Catla catla, Cirrhina mrigala, and Labeo rohita, were examined when they were 480 days old by biochemical tests and electrophoresis of the blood and plasma. The three species did not differ significantly in total plasma albumin. The three species did not differ significantly in total plasma protein (micro-Kjeldahl), relative amounts of total plasma protein and total lipoprotein, and plasma albumin. Significant differences were found in body weight, blood sugar, a_1-, a_2-, β-, and γ-globulin fractions from the plasma, and lipoprotein fractions. Electrophoretic studies revealed two qualitatively different components: a second hemoglobin band in Catla catla, and a third lipoprotein fraction designated a_F in Cirrhina mrigala. The three species were found to differ significantly when weight, blood sugar, a_1-, a_2-, β-, and γ-globulin fractions from the plasma were considered simultaneously. (Auth. abst.)

4123. Hatch, Richard W. 1961. REGULAR OCCURRENCE OF FALSE ANNULI IN FOUR BROOK TROUT POPULATIONS. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp 6-12.

False annuli were found in 65 to 90 percent of brook trout (Salvelinus fontinalis) specimens of several year classes sampled in four Adirondack lakes. Maximum age of fish present was known since all four lakes were recently reclaimed. One or two false annuli were found on scales of trout planted

as advanced fry or hatched from eggs deposited naturally. A method of identifying accessory checks based on scale measurements was developed for determining age of these trout. Influence of environmental temperature on growth rate is discussed as a possible explanation for formation of false annuli. (Auth. abst.)

4124. Chapoton, Robert B., and James E. Sykes. 1961. ATLANTIC COAST MIGRATION OF LARGE STRIPED BASS AS EVIDENCED BY FISHERIES AND TAGGING. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 13-20.

During studies of Atlantic coast striped bass, Roccus saxatilis (Walbaum), by the U. S. Fish and Wildlife Service and co-operators from 1955 to 1959, 478 large fish ranging in weight from 6 to 54 pounds and in age from 3 to 18 years were tagged. Tagging locations were the North Carolina coast, where 81 fish were tagged; Albemarle Sound and Roanoke River, North Carolina, where 97 fish were tagged; and Chesapeake Bay and tributaries, where 300 tags were applied. Catches by commercial and sport fisheries indicated that large striped bass concentrated on the coast of North Carolina in late fall and winter, on or near spawning areas for striped bass in North Carolina and Chesapeake Bay in late winter and spring, and along the coast north of Chesapeake Bay as far as Massachusetts in the summer and fall. Recaptures were made of 19 fish tagged on the North Carolina coast; 23 tagged in Albemarle Sound and the Roanoke River, North Carolina; 27 tagged in Chesapeake Bay and its tributaries; and 1 tagged in the Thames River, Connecticut. Some fish were recaptured near the tagging location but most of them migrated along the coast and were caught in other concentration areas during the season of greatest fishing pressure. (Auth. abst.)

4125. Boyar, H. C. 1961. SWIMMING SPEED OF IMMATURE ATLANTIC HERRING WITH REFERENCE TO THE PASSAMAQUODDY TIDAL PROJECT. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 21-26.

To predict possible effects of the dams and gates of the proposed Passamaquoddy Tidal Power Project on herring movement in and out of the Passamaquoddy Bay region, information was first needed on the swimming performance of the fish. Maximum and sustained swimming speed tests designed for this purpose indicated (1) that the maximum swimming speed for herring 60 to 219 millimeters long ranged from 2.3 to 4.4 feet per second, and (2) that the swimming endurance (length of time a fish was able to swim in a particular water velocity) for herring of similar lengths exposed to water velocities of 1.2 to 3.2 feet per second ranged from 1 to 115 minutes. If the fish responds in the field as in the laboratory, the filling gates that operate at flood tide and emptying gates that operate at ebb tide would not appear to prevent migration. (Auth. abst.)

4126. Bjornn, Ted C. 1961. HARVEST, AGE STRUCTURE, AND GROWTH OF GAME FISH POPULATIONS FROM PRIEST AND UPPER PRIEST LAKES. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 27-31.

Priest and Upper Priest Lakes located in northern Idaho produced a catch of approximately 100,000 fish in 1956. The catch was composed of kokanee (93 percent), cutthroat trout (5 percent), and Dolly Varden and lake trout (2 percent). Three out of four fishermen were nonresidents, and a third of the hours fished were expended by anglers from more than 600 private cabins. The average rate of catch for kokanee was 2.5 fish per boat per hour on Priest Lake and 0.9 on Upper Priest Lake; for cutthroat trout it was 1.0 fish per boat per hour on the upper lake and 0.7 on Priest Lake. Juvenile cutthroat trout were found to spend 2 to 3 years in tributary streams before entering the lakes. The catch and spawning escapements of kokanee from Priest Lake during 1955 and 1956 were composed chiefly of fish in their fifth year of life. (Auth. abst.)

4127. Zein-Eldin, Zoula P. 1961. PLANKTON PIGMENTS IN EAST LAGOON, GALVESTON, TEXAS. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 32-41.

Pigment analyses have been made of a lagoon emptying into the Gulf of Mexico. This water showed a typical cycle of early spring flowering, later spring minimum, summer oscillations, and a secondary early fall maximum. The cycle resembled those of more northern waters, but the blooms in East Lagoon occurred earlier in the year. The bloom periods were related to various physical factors - solar radiation, temperature, and rainfall--with a direct relationship between incident radiation and chlorophyll a production indicated for the fall of 1957. The chlorophyll production of the lagoon compared favorably with other waters in these latitudes, yielding a mean of 17.6 mg chlorophyll a/m^3 during the sampling period from October 1957 to May 1959. An analysis of the precision of the method indicated a standard error of 0.665 ± 0.085 mg/m^3 for chlorophyll a and 1.35 ± 0.165 MSPU/m^3 for chlorophyll c. The large value for the latter pigment is attributed to the method of calculation. (Auth. abst.)

4128. Rothschild, Brian J. 1961. PRODUCTION AND SURVIVAL OF EGGS OF THE AMERICAN SMELT, OSMERUS MORDAX (MITCHILL), IN MAINE. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 42-48.

Egg production and egg survival of the American smelt, Osmerus mordax (Mitchill), were studied during the 1958 spawning run at Dean Brook, Ellsworth, Maine. The construction, number, and location of sampling units utilized in the estimate of egg production and egg survival are discussed. Egg production was $13,726,351 \pm 3,525,971$ and egg survival was $3,423,177 \pm 610,384$. Regressions of egg density and egg survival upon distance above the stream mount are computed. An index of spawning activity could not be related to observed environmental variables. A density of smelt eggs for hypothetical maximum prolarval production was 11,745 eggs per square foot. Maximum prolarval production occurred in regions of

moderate smelt egg deposition. Sources of egg mortality are noted and a nonstatistical estimate of prolarval production is presented: 75, 440. A total egg mortality of 99.5 percent is indicated. (Auth. abst.)

4129. Hooper, F. F., H. A. Podoliak, and S. F. Snieszko. 1961. USE OF RADIOISOTOPES IN HYDROBIOLOGY AND FISH CULTURE. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 49-57.

Use of radioisotopes has increased rapidly in hydrobiology and fish culture. Their use, especially P^{32}, to study circulation of nutrients has been demonstrated and offers opportunities in problems of lake metabolism. The most extensive use of isotopes has been to determine photosynthetic activity in plankton through C^{14} uptake. Applications and limitations are discussed. Isotopes have been successfully used in food studies of fish to determine food selection, metabolism, and storage. Water movements in fresh and salt water and in sewage problems have been successfully followed by use of various isotopes. Marking of aquatic animals with radioisotopes has many possible applications, but has been little used because of some inherent problems related to danger to organisms and in field use. Extent of future use of isotopes in hydrobiology will be determined by further study of hazards and public acceptance of field studies. (Auth. abst.)

4130. Schoeneman, Dale E., Richard T. Pressey, and Charles O. Junge, Jr. 1961. MORTALITIES OF DOWNSTREAM MIGRANT SALMON AT McNARY DAM. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 58-72.

A 3-year study was conducted to determine mortality rates for downstream migrant salmonids passing through spillways or turbines at McNary Dam. Mortalities were determined by releasing marked fish into the exit under study (spillway or turbine) and marked control groups immediately below the dam. Samples of released fish were recovered at stations below the dam, and survival rates were computed from the ratio of the number of experimental to control recoveries. Detailed techniques were devised to test assumptions involved in the estimating procedure. In 1955 and 1956 estimates were obtained for fingerling chinook salmon (Oncorhynchus tshawytscha) at McNary Dam. In 1957 yearling chinook were tested at Big Cliff Dam, a structure of the Santiam River with a turbine and spillway similar to those at McNavy Dam. As a control measure, fingerling chinook were also tested in 1957. In all experiments the turbine was the major source of mortality. For each exit, no significant difference was found between mortalities at McNary Dam and Big Cliff Dam on fingerling chinook or between mortality rates for fingerling and yearling chinook. Estimated mortality rate of salmon passing over the spillway was 2 percent with a 95 percent confidence interval from 0 to 4 percent. Estimated mortality of salmon passing through the turbines was 11 percent with a confidence interval from 9 to 13 percent. The consistency of the results of the studies indicated that the estimates were valid representations of the mortalities experienced under the tested conditions. (Auth. abst.)

4131. Kleerekoper, H., Grace Taylor, and R. Wilton. 1961. DIURNAL PERIODICITY IN THE ACTIVITY OF PETROMYZON MARINUS AND THE EFFECTS OF CHEMICAL STIMULATION. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 73-78.

Both the transforming ammocoete and parasitic Petromyzon marinus display an endogenous cyclic activity rhythm. The rhythm is gradually lost in constant conditions of dim light but is re-established by exposing the animal to one or two artificial diurnal light cycles. The period of the endogenous cycle in one larva was 22 hours 58 minutes. Rhythm in the parasite can also be re-established by exposing the animal during a single short period to chemical sensory stimulation produced by the scent of fish. Diurnal rhythm so established was maintained during a period of 5 days at the end of which the observations ceased. Sensory stimulation can function as a "setting" mechanism of the physiological clock. In this instance the setting mechanism is not related to the metabolism of the animal but must have its seat in the central nervous system. (Auth. abst.)

4132. Brown, Bradford E. 1969. DIFFERENTIAL SEX MORTALITY ASSOCIATED WITH HANDLING LANDLOCKED ALEWIVES. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 80-81.

Fish dying during transportation were sexed, and in every case the number of females per 100 males was greater than that in the original sample. This differential mortality, coupled with the variation in sex ratios of the lots seined from Cayuga Lake, makes it advisable to sex fish during transplanting operations.

4133. Latta, William C., and Gerald F. Myers. 1961. NIGHT USE OF A DIRECT-CURRENT ELECTRIC SHOCKER TO COLLECT TROUT IN LAKES. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 81-83.

At the Pigeon River Trout Research Station, Vanderbilt, Michigan, a direct-current shocker has been used in small trout lakes with considerable success. The collecting is done at night, from a boat. A Homelite direct-current generator (230 volts, 9.3 amperes) provides power both for underwater illumination and for an electrical field to attract fish.

4134. Hubley, Raymond C., Jr. 1961. INCIDENCE OF LAMPREY SCARRING ON FISH IN THE UPPER MISSISSIPPI RIVER, 1956-58. Transactions of the American Fisheries Society, Vol. 90, No. 1, pp. 83-85.

The parasitic fresh-water species of lampreys are not detrimental to the fish population of the upper Mississippi River. The incidence of lamprey scarring on fish captured during the surveys was insignificant.

4135. Carlisle, John G., Jr., Jack W. Schott, and Norman J. Abramson. 1960. THE BARRED SURFPERCH (AMPHISTICHUS ARGENTEUS AGASSIZ) IN SOUTHERN CALIFORNIA. California Department of Fish and Game, Marine Resources Operations, Fish Bulletin No. 109, 79 pgs.

Reproduction, age and growth, food habits, harvest, movements and management recommendations for the barred surfperch are discussed.

4136. Lindgren, Per Erik. 1960. ABOUT THE EFFECT OF ROTENONE UPON BENTHONIC ANIMALS IN LAKES. Fishery Board of Sweden, Institute of Freshwater Research, Drottningholm, Report No. 41, pp. 172-184.

For the complete poisoning of lakes as a rule rotenone concentrations of about 0.5 mg/litre are used which are considered sufficient for the complete extermination of the populations of fish. Enros and Molin assert, however, that 0.3 mg/litre are sufficient at least in theory. The roach is, however, more resistant, and requires 0.7 mg/litre (Oquist).

How does this concentration act upon the invertebrates of the bottom? On the basis of the writer's experiments and the information found in literature this question can probably be answered in the following way.

The invertebrates of the bottom exhibit sensitivity to the poison already at a concentration of 0.5 mg/litre. The use of higher concentrations thus implies great risk for the partial or complete disappearance of the invertebrate populations.

The invertebrates are, however, less sensitive to rotenone than the fishes which suffer from the poison in a physiologically different way (Cutkomp, Hamilton). The invertebrates have in addition on the whole better chances of escaping the poison in one way or the other than the fishes. On this account we have good reason to assume that even after complete extermination of the stock of fish and a fairly considerable reduction of the populations of the invertebrates a sufficient number of the latter will survive in order to guarantee their continued existence in the poisoned lake. (Auth. concl.)

4137. Chevrier, J. R., and R. W. Trites. 1960. DRIFT-BOTTLE EXPERIMENTS IN THE QUODDY REGION, BAY OF FUNDY. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 6, pp. 743-762.

In conjunction with the research program of the International Passamaquoddy Fisheries Board, approximately 10,000 drift bottles were released in the Quoddy Region of the Bay of Fundy in 1957 and 1958. Overall return of bottles was 25%. Results have been analyzed and surface drift inferred on monthly and seasonal bases. On the average, there is a counter-clockwise circulation in Passamaquoddy Bay, an outflow through Western Passage, a variable flow in Letite Passage, an outflow on the Campobello side and an inflow along the Deer Island side of Head Harbour Passage. In the outer Quoddy Region, there is evidence of a clockwise circulation around The Wolves, a variable flow in Grand Manan Channel, and a southerly movement off the east coast of Grand Manan Island.

Wind speed and direction, which vary seasonally, appear very effective in altering the pattern of drift. (Auth. abst.)

4138. Axorr, S. M., and W. F. Black. 1960. STUDIES ON THE LIFE-HISTORY OF THE ASCARID PORROCAECUM DECIPIENS IN THE BRAS D'OR LAKES, NOVA SCOTIA, CANADA. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 6, pp. 763-774.

Larvae of the parasitic ascarid (Porrocaecum decipiens) occurred commonly in the musculature and viscera of Atlantic cod (Gadus morhua) in the Brad d'Or Lakes. They were also present in the musculature of nine other species of teleosts and probably also in the viscera of skates (Raja sp.). Most larvae were longer than 20 mm. None was shorter than 10 mm, a fact which suggested the existence of some earlier intermediate host, probably an invertebrate. More than 8,000 mysids, an important food of fishes when they first become infected, were examined for nematodes. Although 110 nematodes were found, only one certainly and four dubiously appeared to be Porrocaecum. The definitive hosts were the harbour seal (Phoca vitulina) and the grey seal (Halichoerus grypus). The distribution of seals coincided with local variations in the incidence of the parasite in cod. (Auth. abst.)

4139. Fleming, A. M. 1960. AGE, GROWTH AND SEXUAL MATURITY OF COD (GADUS MORHUA L.) IN THE NEWFOUNDLAND AREA, 1947-1950. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 6, pp. 775-809.

Samples of cod were collected from fishing gears in the coastal areas of Newfoundland and Labrador and from research otter-trawlers on the neighbouring banks from 1947 to 1950. Collections for the most part were from early summer to early autumn. Ages were determined using otoliths. Calculations of growth were based on average lengths and weights of the different age-groups in the samples.

The growth rates of cod from various parts of the area were found to differ widely. Labrador cod had the slowest growth rate, much slower than cod from other parts of the area. Cod from the east coast of Newfoundland and the northeastern part of the Grand Bank were also slow-growing. Cod from the southwestern part of the Grand Bank had the fastest growth rate. Though cod from St. Pierre Bank and southwestern Newfoundland were fast-growing, also, they exhibited a somewhat slower growth rate than those from the southwestern part of the Grand Bank. Cod from the west coast of Newfoundland grew faster than cod from the east coast, but slower than those from southwestern Newfoundland.

Though differences in growth rate were small between the sexes, the females generally grew at a slightly faster rate.

The influence of differences in temperature and in food supply on the growth of cod in the area is discussed.

Comparable growth data for the area published by

several investigators are discussed. It is suggested that differences in these data were the result of variation in sampling locality, different sampling gears, different combination of individual samples and differences in age estimation.

Both the size and age at which all fish were sexually mature varied throughout the area of investigation. Labrador cod matured at an earlier age and smaller size than cod from other parts of the area, whereas cod from the southwestern part of the Grand Bank generally matured at a later age and larger size than cod from other parts of the area. Cod from the east coast of Newfoundland, the northeastern part of the Grand Bank, St. Pierre Bank and the southwest and west coasts of Newfoundland were intermediate between cod from Labrador and the southwestern part of the Grand Bank in age and size at maturity, fish from the east coast generally maturing at an earlier age and smaller size than fish to the south on the Grand Bank and St. Pierre Bank and from the southwest and west coasts.

The age, growth and sexual maturity relationships of cod from various parts of the area, when analyzed in the light of tagging experiments, meristic studies, parasite studies and hydrographic information, suggest the existence of at least four relatively distinct divisions in the cod population of the area, between which there is only limited intermingling. These are the Labrador, the Newfoundland east coast, the southern Grand Bank and the Newfoundland west coast divisions, with areas such as St. Pierre Bank and the Strait of Bell Isle being mixing areas of cod from adjacent divisions. (Auth. abst.)

4140. McCombie, Alen Milne. 1960. ACTIONS AND INTERACTIONS OF TEMPERATURE, LIGHT INTENSITY AND NUTRIENT CONCENTRATION ON THE GROWTH OF THE GREEN ALGA, CHLAMYDOMONAS REINHARDI DANGEARD, Journal of the Fisheries Research Board of Canada, Vol. 17, No. 6, pp. 871-894.

The unicellular green alga, Chlamydomonas reinhardi, was cultured at several temperatures in Chu's No. 10 medium under 150 foot-candles illumination. Specific growth rates based on cell counts were found to fit a typical activity curve. The range of temperature tolerance was 6°C to 35°C and the optimum was 28°.

The culture series was repeated at light intensities of 75, 110 and 200 f-c in turn. These changes in illumination did not alter the limits of temperature tolerance or the optimum, though the reduced intensities caused decreases in growth rates. At the reduced intensities light acted as the typical limiting factor. At 200 f-c the growth temperature relation was the same as that for 150 f-c, indicating that some factor other than light intensity had become limiting at the latter levels.

The series was then repeated with the light intensity held at 200 f-c but with the total concentration of nutrient salts doubled. This accelerated growth between 12° and 30°, showing that some nutrient salt was indeed the limiting factor in the experiments with 200 f-c. However, the increase in salt concentration also shifted the lower limit of temperature tolerance up to 12° and moved the optimum down to 18°. Hence the salt concentration must have played some role besides that of limiting factor.

Finally, the results of this investigation are discussed from the standpoint of the system of environmental factors described by Fry (1947) and some of the ecological implications of the observations are considered. (Auth. abst.)

4141. Rawson, D. S. 1960. FIVE LAKES ON THE CHURCHILL RIVER NEAR STANLEY, SASKATCHEWAN. Fisheries Branch, Department of Natural Resources, Province of Saskatchewan, Canada, Fisheries Report No. 5, 39 pgs.

The fish fauna shows the influence of the relatively warm, river flow. It lacks the lake trout and has two characteristic river species, the sauger and redhorse sucker. It also includes the fathead minnow, a species not usually found in northern Precambrian lakes.

The bulk of the fish caught in our test nets was made up of ciscoes, pickerel, white suckers, whitefish and pike, in decreasing order of magnitude. The average weight per net set was high, 206 pounds, as compared to Waskesiu 134, La Ronge 156, and the large northern lakes of Saskatchewan about 100 pounds. Only Big Peter Pond (281 pounds) had a higher average catch.

Growth rates of pike and whitefish were somewhat higher than those in the Upper Churchill Lakes. The sauger is apparently near the northern limit of its range and grows a little slower than it does in Lake Manitoba.

The outstanding feature of the fish feeding in these lakes is the high proportion of "bottom" foods, such as mayfly nymphs and crayfish, eaten by pike, pickerel, perch, saugers and burbot, which are normally thought of as fish eaters. The whitefish ate all the main bottom foods, viz., chironomid larvae, sphaeriids, amphipods and mayfly nymphs.

Considering all the evidence available, it would seem that these lakes should produce useable fish at the rate of 3 to 4 pounds per acre per year. This would provide for a great expansion in the angling fishery for pickerel and pike, a substantial domestic catch mainly from Mountain Lake, and a modest commercial operation mainly for whitefish but with a generous tolerance for pickerel. Much greater production could be achieved if the ciscoes (tullibee) and suckers could be used for mink feeding.

It is suggested that about two-thirds of the production from Otter be reserved for angling, since the new road will bring a great increase in angling pressure. Much of the production in Mountain Lake can be used by domestic fishing and angling. About one-half of the production in Nistowiak and Drinking might be taken by angling and the other half used commercially.

4142. Schaefer, Richard H. 1960. GROWTH AND

FEEDING HABITS OF THE WHITING OR SILVER HAKE IN THE NEW YORK BIGHT. New York Fish and Game Journal, Vol. 7, No. 2, pp. 85-98.

A total of 1,931 whiting were sampled from two fishing locations (Long Branch Pier and the "Mud Hole") in the New York bight from December 1957 through May 1958. All were measured for total length, and the weights of 455 were recorded. Sex was determined for the adults. Otoliths from 287 specimens, and stomach contents from 338, were preserved.

Calculated growth rates showed a highly significant difference between the sexes, but there was no evidence that growth of either sex varied with time or location. Neither was there evidence that length-weight relationships differed significantly.

Various amphipods and shrimps, together with glut herring and silversides, were the food items most frequently eaten. In the offshore area, whiting had taken smaller fish of their own kind to a considerable degree. (Auth. abst.)

4143. Haskell, David C., Richard O. Davies, and James Reckahn. 1960. FACTORS IN HATCHERY POND DESIGN. New York Fish and Game Journal, Vol. 7, No. 2, pp. 112-129.

Three aspects of pond design were investigated as applied to rectangular rearing ponds, i.e., water circulation, water aeration, and screen size. It was found that for best circulation the inlet and outlet should be the same width as the pond. Any of the tested modifications of a simple dam at pond outlets improved aeration. A flat rack with its upstream edge on top of the dam was one of the most effective aeration devices. Screen areas sufficient to provide 1 square foot of usable (underwater) screen for each 25 gallons per minute flow are recommended. (Auth. abst.)

4144. Harris, Earl J. 1960. QUANTITATIVE DETERMINATION OF COPPER IN A NATURAL RECEIVING WATER WITH 2, 2' BIQUINOLINE. New York Fish and Game Journal, Vol. 7, No. 2, pp. 149-155.

A rapid, accurate method for the colorimetric determination of copper in water is described, based on the purple-colored complex formed by the reaction of 2, 2' biquinoline (or cuproin as it is sometimes called) and the cuprous ion resulting from reduction with hydroxylamine. The complex is stable in a pH range of 5.3 to 6.0 and is easily extracted with a water-immiscible solvent. The technique is simple and rapid and it gives reproducible results under routine conditions. It is felt the procedure offers desirable advantages over the carbamate procedures. (Auth. abst.)

4145. Galligan, James P. 1960. WINTER FOOD HABITS OF PIKEPERCH IN ONEIDA LAKE. New York Fish and Game Journal, Vol. 7, No. 2, pp. 156-157.

During the winters of 1951-52 and 1952-53, an ice-fishing check was made on Oneida Lake and 143 pikeperch stomachs were examined. Of these, 112 (78.3 per cent) were empty, 20 (14.0 per cent) contained fish, and 11 (7.7 per cent) contained insect larvae. Foods identified in those stomachs containing food are listed.

4146. Zilliox, Robert G., and Martin Pfeiffer. 1960. THE USE OF ROTENONE FOR MANAGEMENT OF NEW YORK TROUT WATERS. The Canadian Fish Culturist, Issue Twenty-eight, December, 1960, pp. 3-12.

Rotenone products have been used in the reclamation of many New York waters at a concentration of approximately 0.5 p.p.m. Prior to reclamation, due to the presence of introduced non-native species of fish, these waters provided little if any angling. Annual stocking, with fingerling trout, following treatment, provides remunerative trout fishing in most instances. Complete eradication of the introduced species of fish described, in natural lakes and ponds of New York, is almost a certainty by use of emulsifiable rotenone at a concentration of 0.5 p.p.m. The complete eradication of certain native species of fish is not a certainty. Although it is desirable to eliminate all species of fish, the eradication of the introduced species can be considered sound fisheries management.

Due to the relatively rapid loss of toxicity, the knowledge of its capabilities, its acceptance by the general public, health authorities and fishery administrators, the use of rotenone as a fish toxicant can be expected to continue even as other more efficient and less costly products become available. Certain waters in New York will probably continue to be treated with rotenone products in the near future due to their location, conflicts with riparian rights and possible involvement with human water supply sources. (Auth. concl.)

4147. Prevost, Gustave. 1960. USE OF FISH TOXICANTS IN THE PROVINCE OF QUEBEC. The Canadian Fish Culturist, Issue Twenty-eight, December, 1960, pp. 13-35.

Rotenone is a fish toxicant used since 1934 but Toxaphene, Endrin and Thiodan, relative newcomers in the field, are the ones mainly studied, first in the laboratory and then in the lakes. A standard method for laboratory work is stressed. Source and ontogenesis of the fish, temperature and volume of the water have a definite effect on the results obtained. In treating natural waters, many factors have to be cared for, e.g. thermocline, weed beds, floating islands, springs, temperature, turbidity, alkalinity of the water, source of the stream. Rotenone has very little effect on food organisms, while Toxaphene has a very prejudicial one, though some species of plankton are more resistant than fish. Toxicity of the water can be checked in the laboratory or in the lake, but no practical method of accelerating detoxification has been worked out yet, although bentonite gives hope. Health hazards are very small. Stocking with speckled trout gives spectacular results in lakes poisoned with Rotenone, but with the other toxicants, delay in the fishing can be long and no definite fishing results have been found or published. Rotenone is still the best

product to use but it is very costly, compared with the others. (Auth. abst.)

4148. Stringer, George E., and Robert G. McMynn. 1960. THREE YEARS' USE OF TOXAPHENE AS A FISH TOXICANT IN BRITISH COLUMBIA. The Canadian Fish Culturist, Issue Twenty-eight, December, 1960, pp. 37-44.

Decision as to what concentration of toxaphene should be used for a particular rehabilitation depends upon a number of factors. Species and size of fish, depth, stratification, flushing rate and turbidity all must be weighed. Although depth and stratification seem to chiefly determine the rate, wind, sunlight, and micro-organisms on the bottom affect the toxaphene breakdown. In shallow basins there is a larger percentage of contact at the mud-water interface and breakdown is more rapid under these conditions. Toxaphene in the hypolimnion probably breaks down slowly during the year as the thermocline and ice cover inhibit circulation. It would appear that the major influence on the lower strata of landlocked lakes is through mixing during the fall turn-over.

Annual run-off figures can be helpful in predicting clearing time and selection of concentration. Small lakes that flush rapidly require doses in excess of minimum because of extended "killing time" in the lower concentrations.

Treatment of turbid lakes has not been satisfactory at concentrations of 0.02 p.p.m. Although a large percentage of the fish population was killed, many fish do survive, particularly those in the larger size ranges. These partial kills illustrate differences in individual tolerances. If detoxification is rapid the more tolerant species may not be seriously affected before a sublethal level of toxaphene is reached.

Minimum dose for small fish such as shiners and sculpins approximates 0.003 p.p.m. and slightly higher for other species. Since 0.006 to 0.0075 p.p.m. may be needed for most rehabilitations, duration of toxicity for deep, clear and stratified lakes in British Columbia will be in the order of two years. When treating such lakes, it is essential to use a minimum concentration of toxaphene, or the lake will remain toxic for a prolonged period.

The toxaphene used in British Columbia is classified as a livestock spray. Viobin (Canada) Limited report the use of an emulsifier which lessens stability, apparently rapid dispersion is followed (in ten days to two weeks) by a settling of the emulsion. The toxaphene is then subject to detoxification by soil organisms. A comparison of the two mixtures would be desirable.

In streams the rapid breakdown of toxaphene is likely attributable to adsorption of chemical by gravel and sand substrate. Prevention of heavy downstream fish kills, immediately after application to a lake, may require the impoundment of water in order to allow time for mixing. (Auth. disc.)

4149. McCRIMMON, H. R. 1960. OBSERVATIONS ON THE STANDING TROUT POPULATIONS AND EXPERIMENTAL PLANTINGS IN TWO ONTARIO STREAMS. The Canadian Fish Culturist, Issue Twenty-eight, December, 1960, pp. 45-55.

Studies were made on two small southern Ontario trout streams representing two common but dissimilar types of streams stocked annually with hatchery-reared speckled trout. The trout population of Stream A was dependent entirely on these plantings. Stream B supported a substantial population of native trout. Standing resident trout populations at the opening of the trout season were 0.01 and 0.13 fish per yard in the respective streams. Spring plantings of yearling hatchery-reared trout increased these populations to a density of 0.02 and 0.15 trout per yard, respectively, but contributed nothing directly to the legal-sized trout population (fish 7" or over) of approximately 0.01 trout per yard in both streams.

Five plantings of advanced fingerling or yearling trout at densities of 0.01 to 0.09 fish per yard resulted in the establishment in the streams of from three per cent to 53 per cent of those trout planted. The natural over-winter repopulation of Stream B by trout from neighbouring waters proved more efficient in re-establishing a trout population than did an autumn planting of 200 advanced fingerling fish. The annual restocking policy for this stream with adequate natural reproduction was observed to be an unnecessary and perhaps harmful practice. Studies in Streams A and B point out the necessity of an ecological basis for fish planting programmes.

Studies in Streams A and B indicated that legal length limits (7" T. L. in Ontario) serve no useful purpose in the management of southern Ontario trout streams but rather may limit the potential harvest of both native and planted trout. (Auth. abst.)

4150. Mathis, William, and Andrew Hulsey. 1959. ROUGH FISH REMOVAL FROM LAKE CATHERINE, ARKANSAS. Southeastern Association of Game and Fish Commissioners Thirteenth Annual Conference, 1959, pp. 197-203.

Following the recommendations of a three-year comparative fishery study of Lakes Ouachita, Hamilton and Catherine near Hot Springs, Arkansas, a rough fish removal project was carried out on 3,000-acre Lake Catherine, October 25, 1958. The chemical (Pro-Noxfish) was applied at varying concentrations over approximately three-fourths of the drawdown area of the lake. The water level was manipulated so that the treated water infiltrated the untreated portions. As a result, a selective shad and drum kill was obtained over the entire area of the lake. Bank counts failed to give an acceptable quantitative estimate of numbers and weights of fish killed. A more satisfactory estimate was obtained by the use of data obtained from previous rotenone population samples. As part of the management plan, the lake will be restocked with large numbers of yearling and fingerling game fishes. Evaluation of the management work will be carried out by continuing Dingell-Johnson Project F-5-R. (Auth. abst.)

4151. Baker, Robert F. 1960. HISTORICAL RE-

VIEW OF THE BULL SHOALS DAM AND NORFORK DAM TAILWATER TROUT FISHERY. Arkansas Game and Fish Commission, pp. 229-236.

Beginning with a stocking of 600 four- to six-inch rainbow trout in 1948 in the Norfork Dam tailwater located in North Central Arkansas, a fishery soon developed which was entirely new to the area.

With the completion of Bull Shoals Dam in 1952, investigations began which soon showed that the native fishery was destroyed for many miles below the high dams. A trout stocking program carried on in conjunction with an investigational project produced such excellent trout fishing that the area became nationally famous within a few years, and a modern trout hatchery was constructed just below Norfork Dam by the U. S. Fish and Wildlife Service for the purpose of producing trout for stocking the White River and its tributaries. By 1957 trout were being stocked in 91 miles of tailwater streams which supported 47, 792 man days of fishing, generating $684, 732.00 worth of business to the fishing service operators alone. (Auth. abst.)

4152. Christensen, Earl M. 1956. BIBLIOGRAPHY OF UTAH AQUATIC BIOLOGY. Utah Academy Proceedings, Vol. 33, pp. 91-100.

A list of 243 papers.

4153. Scheuermann, William F., Jr. 1958. AN ANNOTATED BIBLIOGRAPHY OF RESEARCH IN ECONOMICALLY IMPORTANT SPECIES OF CALIFORNIA FISH AND GAME. California Legislature, Assembly Interim Committee Reports, Vol. 5, No. 5, 271 pgs.

4154. Lawler, G. H., and G. P. McRae. 1961. A METHOD FOR PREPARING GLYCERIN-STORED OTOLITHS FOR AGE DETERMINATION. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 1, pp. 47-50.

Glycerin-preserved otoliths of burbot, Lota lota, often become opaque and difficult to age; they become readable if heated in glycerin for 10 minutes at 190°C, or for longer times at lower temperatures. (Auth. abst.)

4155. Kerr, Robert B. 1961. SCALE TO LENGTH RATIO, AGE AND GROWTH OF ATLANTIC SALMON IN MIRAMICHI FISHERIES. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 1, pp. 117-124.

The following quadratic equation relating fork length to scale radius is derived for Atlantic salmon taken in the Miramichi commercial fisheries:

$$L = 2.40 + 12.90S + 1.22S$$

where L = fork length in cm; and S = anterior scale radius in mm. The value 2.40 represents the fork length in cm of the fish when the scales first appear. Smolt transformation occurs after the young have reached an approximately similar size (about 12 cm) regardless of age. Five-year-old fish with 3 river years and 2 sea years predominate in the catch. Repeat spawners constitute only about 1/20 of the catch of salmon larger than grilse. (Auth. abst.)

4156. Hochachka, P. W. 1961. LIVER GLYCOGEN RESERVES OF INTERACTING RESIDENT AND INTRODUCED TROUT POPULATIONS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 1, pp. 125-135.

Three groups of trout, two introduced populations of Salmo gairdneri and a resident Salmo clarki, were studied in stream sections. Liver glycogen deposits, which were reduced to low levels during transportation to the stream, were restored in 2 to 3 weeks in all groups, with recovery rates being approximately inverse to the population density. Within the hatchery groups, larger fish laid down greater glycogen stores. Wild trout maintained their high glycogen reserves throughout the experiment. (Auth. abst.)

4157. McAllister, D. E. 1961. NORTHWARD RANGE EXTENSION OF THE FLATHEAD CHUB AND TROUT-PERCH TO AKLAVIK, N. W. T. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 1, pg. 141.

Seine hauls in the Peel Channel of the Mackenzie River delta at Aklavik (68° 13.5' N Lat., 135° 00' W Long.), Northwest Territories, Canada, produced two species north of their recorded range, the flathead chub (Platygobio gracilis) and the trout-perch (Percopsis omiscomaycus).

4158. Ward, Claud. 1959. SPECIAL REPORT: THE FISHES OF NOLICHUCKY RIVER. A Contribution to a Pollution Survey, Tennessee Game and Fish Commission, 31 pgs.

Conditions in the Nolichucky River are not generally suitable for a population of desirable game fishes.

Reproduction of sunfishes was unsuccessful at all mainstream stations.

Reproduction of channel catfish was successful at all stations sampled.

The natural progressive upstream aging of the Nolichucky seems to have been accelerated by siltation.

Particularly adverse conditions are indicated at stations 4 and 6. The small size of the sample from Station 5 is problematical, indicating a possible recent eradication of fishes from that section of the stream.

The sample at Station 9 possibly included fishes from Douglas Lake. Migration both to and from the lake is expected. The extent of migration is unknown. (Auth. concl.)

4159. Mullican, Harold N., Ralph M. Sinclair, and Billy G. Isom. 1960. NOLICHUCKY RIVER STREAM POLLUTION CONTROL. PART I: SURVEY OF THE AQUATIC BIOTA OF THE NOLICHUCKY RIVER IN THE STATE OF TENNESSEE. Tennessee Stream Pollution Control Board, Tennessee Department of Public Health, 28 pgs. and Appendices.

Biological evaluation of the Nolichucky River in 1954, 1956, and 1958 revealed gross pollution. Reduction of the biota was indicative of the magnitude of pollution.

The river entering Tennessee is highly colored with mica and silt. This condition is further aggravated after the stream crosses the state line by silt from a sand and gravel company via North Indian

Creek, and also by raw sewage from the city of Erwin. The adverse effect of these pollutants was reflected in the biota of the first two stations below Erwin, with a reduction of the more sensitive forms, and an increase of the more resistant forms.

The silt and mica exert a two-fold effect on the food chain. Light penetration is inhibited, thus interferring with photosynthesis and suppressing floral development. The solids constitute a shifting unstable bottom that triturates and smothers much of the fauna. (From auth. concl.)

4160. Burrows, Roger E. 1961. NORMAL BEHAVIOR OF CHINOOK SALMON FINGERLINGS. The Progressive Fish-Culturist, Vol. 23, No. 1, pg. 7.

At the Salmon-Cultural Laboratory, wild and hatchery chinook salmon fingerlings were observed for 30-minute periods in a tunnel in which water velocities were from 0.4 to 1.8 feet per second.

Initially the stop screen at the head of the tunnel was made of 0.25-inch hardware cloth. When the water velocity neared 1.5 feet per second, some fish--both wild and hatchery--would swim forward and cling to the screen by the teeth of the lower jaw. They hung on and maintained themselves with little effort. After this screen was replaced with a perforated vertical-slot screen, they continued--with much less success--to try to attach themselves in fast currents by clinging to stationary objects.

4161. Snyder, George R., and Howard A. Tanner. 1960. CUTTHROAT TROUT REPRODUCTION IN THE INLETS TO TRAPPERS LAKE. State of Colorado Department of Game and Fish, Technical Bulletin Number 7, 86 pgs.

During the two years of this study the spawning run began the second week of June, peaked around June 25, and ended by the middle of July. A total of 5,333 cutthroat trout in 1958 and 4,870 cutthroat trout in 1959 are estimated to have migrated into the three inlets for spawning. Of this total, approximately 75 percent of the fish entered Cabin Creek. Two sub-species of cutthroat trout, the Colorado River and the Yellowstone, made up the bulk of the spawning population. Rainbow trout were observed in small numbers. Spawn was collected from 45 to 56 percent of the total adult fish during 1958 and 1959, respectively. All of the fish utilized in spawn collection came from Cabin Creek. The average size of all migrating fish in 1958 was 11.6 inches and 234 grams, and 12.4 inches and 290 grams in 1959. In 1958, age group III seemed to predominate in all three streams, age group II ranked second. Age group IV fish dominated the 1959 migration. In the spawning population, the ratio of males to females was 1:1.5 and 1:3.1 for 1958 and 1959, respectively. Approximately 16 percent of the 1958 spawning run returned to spawn again in 1959, and 92 percent of the returnees were Colorado River cutthroat trout. The average fecundity was 673 eggs per female in 1958 and 848 eggs per female during 1959. The natural production of cutthroat trout eggs in the three inlets was an estimated 985,000 in 1958 and 1,270,000 in 1959. Approximately 841,000 eggs were taken by spawning crews in 1958 and 1,242,000 eggs in 1959. Quantitative data established a nocturnal fry migration pattern which peaked at approximately 9:00 p.m. Very few fry migrated downstream between 6:00 a.m. and 6:00 p.m. A total of 59,180 fry were estimated to have moved downstream during 1958. Of this total, 38,000 moved down Cabin Creek. A total of 67,183 fry were counted in the three inlets to Trappers Lake during 1959, and of this total 62,346 fry were tabulated in Cabin Creek. (From auth. summ.)

4162. Conover, John T., Raymond L. Fritz, and Manuel Vieira. 1961. A MORPHOMETRIC STUDY OF SILVER HAKE. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 368, 13 pgs.

Evidence is presented that the silver hake population along the Atlantic coast is comprised of two separate groups. One group inhabits the waters off the New England coast and the other is found off the southern New England, New York, and New Jersey coasts. Two characters, head length and pelvic fin length, gave consistent differences for separating these groups during two seasons of the year. The data were analyzed by appropriate F-tests in an analysis of covariance and by a T-test for the distance between regression lines. (Auth. abst.)

4163. Bowden, Kenneth L. 1961. A BIBLIOGRAPHY OF STRIP-MINE RECLAMATION, 1953-1960. Department of Conservation, University of Michigan, 13 pgs.

4164. Cassie, Morrison, and Vivienne Cassie. 1960. PRIMARY PRODUCTION IN A NEW ZEALAND WEST COAST PHYTOPLANKTON BLOOM. New Zealand Jour. Sci., Vol. 3, No. 2, pp. 173-199; Biological Abstracts, Vol. 35, No. 24, Abst. No. 69382. 1960.

Dense phytoplankton blooms, frequently visible to the unaided eye, are of common occurrence in the waters off many west coast beaches in the North Island of New Zealand, particularly in the winter months. The dominant species is Chaetoceros armatum (?) (probably a new species) while Asterionella japonica may be abundant at times. These blooms support a large biomass of benthic and nektonic species, but zooplankton is relatively scarce. Daily samples at 0930 were taken from a point near the entrance to Waitarere beach from 11 to 21 August 1959. Measurements were made of gross primary production by the light and dark bottle oxygen method with light-bath incubation, and of plant pigments by spectrophotometry of 90% acetone extracts. Quantitative counts were made of phytoplankton. Gross production is estimated as ranging from 20 to 400 mg $C/hr/m^3$ at 10°C and 300 foot candles. Production is correlated to chlorophyll a content (r=0.92) and to number of cells of Chaetoceros armatum (?) (r=0.87). 3-3.5 mg C per hour is utilized per mg chlorophyll a, and (very approximately) 1 mg C per hour per 10^6 Chaetoceros cells. Where production is high the rate of increase in oxygen concentration de-

creases with time, so that the shortest incubation periods (2 hr) are considered the most reliable estimates. This decrease is probably due to modification of the environment in the bottle by photosynthesis, since pH changes of up to 0.2 have been observed. It is considered that the blooms studied are two orders of magnitude less than the maximum that may be reached on this beach, so that the gross instantaneous rate of primary production must at times reach an exceptionally high figure. However, owing to the scarcity of zooplankton predators and the high mortality rate of phytoplankton by stranding, it is likely that plant nutrients are recycled relatively rapidly, so that net production of organic material on an annual basis is not unduly great. It is also possible that environmental changes similar to those observed in the bottles may provide an upper limit to the daily photosynthetic activity of the denser blooms. (Auth. abst.)

4165. Harrison, A. D., P. Keller, and D. Dimovic. 1960. ECOLOGICAL STUDIES ON OLIFANTSVLEI, NEAR JOHANNESBURG, WITH NOTES ON THE DIATOMS BY B. J. CHOLNOKY. Hydrobiologia, Vol. 15, No. 1/2, pp. 89-134; Biological Abstracts, Vol. 35, No. 24, Abst. No. 69393. 1960.

A survey carried out to study the effect of the marsh, Olifansvlei, on the polluted waters of the Klip and Klipspruit streams which flow through it. Both streams receive run-off from gold mine dumps which contain a large amount of free sulphuric acid which is slowly neutralized by the dolomite formations over which the streams flow. The Klipspruit receives organic pollution from sewage works effluents. Samples were collected at eight stations and analyzed chemically. Estimations of the fauna, and phytoplankton, diatom and bacterial populations were also made. The results of these analyses are given in tables. During its passage through the swamp there was a marked reduction in the concentration of nitrate nitrogen present in the water. Bacterial purification was also marked. (K. E. M.)

4166. Maekawa, Tadao, Takeshi Wakiya, and Hiroshi Yokose. 1959. STUDIES ON THE PHASE OF IRRIGATIONAL RESERVOIRS--ON THE PLANKTON. (In Japanese with English summ.) Tech. Bull. Fac. Agric. Kagawa Univ. 11(Spec. Issue): 99-110; Biological Abstracts, Vol. 35, No. 24, Abst. No. 69394.

The environmental characteristics of irrigation reservoirs are discussed from their plankton flora. In the irrigation season, the population of plankton was largest in field reservoirs, intermediate in hillside reservoirs, and lowest in mountain reservoirs. The population of plankton increased gradually through June and July, reached the maximum peak in August, and decreased during the following season to October, similarly in all the three kinds of reservoirs examined. Thirty-two species of plankton were isolated from reservoirs in the present research 18 species were zooplankton, 9 phytoplankton, and 5 were unidentified. Relatively dominant species were Diaptomus sp., Chydorus Sphaericus, Sida crystallina, Ceratium hirundinella and Simocephalus serrulatus, as zooplankton; and Coelosphaerium kutzingianum, Clathrocytis aeruginosa, and Leptocylindrous sp. as phytoplankton. (Auth. abst.)

4167. Poll, M. 1959. ECOLOGICAL INVESTIGATIONS ON THE ICHTHYOLOGICAL FAUNA OF STANLEY POOL. (RECHERCHES ECOLOGIQUES SUR LA FAUNE ICHTHYOLOGIQUE DU STANLEY-POOL.) Ann. Soc. Roy. Zool. Belgique, Vol. 89, No. 1, pp. 183-201; Biological Abstracts, Vol. 35, No. 24, Abst. No. 69395. 1960.

Stanley Pool is an immense enlargement of the Congo River, with a surface area of about 500 sq. km., including a large island Bamu and an archipelago of small islets and sand banks. Data are given on temperature and physico-chemical characteristics of the water. Fish collecting carried out at 30 stations brought a total of 84 species, representing 20 families, of which Mormyidae is the most important in number of species and in abundance of individuals. The most common species are Petrocephalus grandoculis and P. microphthalmus. These are 4 species of Clupeidae which are present in nearly all catches where the water is flowing, and 2 species of Cyrpinidae are abundant in the pool itself. Data on the occurrence of other families are given and discussed. The fish faunas of the little streams which flow into the pool, the mud of the marshes, and the rapids are each discussed. An ecological segregation is very noticeable. A classified list of species is appended. (A. K. W.)

4168. Stankovic, Sinisa. 1960. THE BALKAN LAKE OHRID AND ITS LIVING WORLD. Monographiae Biologicae. Vol. IX, 357 p.; Biological Abstracts, Vol. 35, No. 24, Abst. No. 69397. 1960.

Lake Ohrid is on the Balkan Peninsula on the Albanian-Yugoslavian border. It is characterized by a wealth of endemic organisms, much greater than any other European lake. It is one of the few great and deep lakes in the Mediterranean region. The physiography, climate, and vegetation of the Balkan peninsula are discussed, followed by detailed analysis of the lake itself, covering physiography, hydrography, water circulation, stratification, heat exchanges, light, currents and seiches, and water chemistry. The composition, vertical distribution, seasonal periodicity, and bacterial content of the plankton are itemized. The benthic community is covered within each of the three main vertical zones of the lake, i. e., littoral, sublittoral, and profundal, and the fauna of the lake shore is discussed. The composition of the fauna of the lake is covered by phyla, with emphasis on the endemic species. A discussion of the tectonics and paleogeography of Lake Ohrid is followed by a biogeographical analysis, with attention focussed on the endemics and relicts. All of the fauna appears to be of freshwater origin. There is a brief discussion of the fisheries resources of the Lake and of the hydrobiological station in Ohrid. (J. A. P.)

4169. Kulaev, B. S. 1957. NERVOUS REGULA-

TION OF THE RHYTHM OF CARDIAC CONTRACTIONS IN FISH. COMMUNICATION I. THE EFFECT OF STIMULATION AND SECTION OF THE CARDIAC BRANCHES OF THE VAGUS OF CARDIAC RHYTHM. Biull. Eksptl. Biol. i Med. (Transl.) 43(7): 771-774; Biological Abstracts, Vol. 35, No. 24, Abst. No. 69830. 1960.

The results of 60 experiments on bony fishes, mostly pike, with stimulation of the peripheral ends of the cardiac branches of vagal nerves are reported. Frequency of heart contractions varied in accordance with the intensity of stimulation: in one and the same experiment the heart would stand still, slow down and hasten its contractions. Bilateral section of the cardiac branches of vagal nerves would cause transient changes of heart contractions in some cases, but no change whatsoever in most of them. Skramlik's theory on the tonus of vagal nerves in fishes must be revised to include the possibility of an active positive chronotropic effect of vagal nerves. (Auth. abst.)

4170. Aasen, O. 1958. ESTIMATION OF THE STOCK STRENGTH OF THE NORWEGIAN HERRING. Jour. Conseil Internatl. Explor. Mer, Vol. 24, No. 1, pp. 95-110; Biological Abstracts, Vol. 36, No. 1, Abst. No. 289. 1961.

Estimates of Atlanto-Scandinavian herring stock are complicated by irregularities in the age-distribution. A "dispersal hypothesis" is presented and a formula for calculating dispersing and re-entering of age groups. It is postulated that there is a dispersal over the feeding grounds following spawning and that a school on reforming for spawning may have a different constitution as a result of the mixing of different stocks. (N. W. R.)

4171. Ball, J. N., and J. W. Jones. 1960. ON THE GROWTH OF THE BROWN TROUT OF LLYN TEGID. Proc. Zool. Soc. London, Vol. 134, No. 1, pp. 1-41; Biological Abstracts, Vol. 35, No. 1, Abst. No. 291. 1961.

Growth was found differential during the seasons, with little occurring in October-February, but appearing again February-March. Some variation in individuals occurs. From 25% of rapidly growing individuals in February-March, 100% is reached in June, July, or August. (A. N. B.)

4172. Lloyd, R., and D. W. Herbert. 1960. THE INFLUENCE OF CARBON DIOXIDE ON THE TOXICITY OF UN-IONIZED AMMONIA TO RAINBOW TROUT (SALMO GAIRDNERII RICHARDSON). Ann. Appl. Biol., Vol. 48, No. 2, pp. 399-404; Biological Abstracts, Vol. 36, No. 2, Abst. No. 311. 1961.

The effect of pH value on the toxicity of ammonia solutions to rainbow trout is not entirely explained by the concentration of un-ionized ammonia in the test solutions; this paper shows that solutions containing equal concentrations of un-ionized ammonia are increased in toxicity by raising the concentration of carbon dioxide. To explain this it is assumed that the gill is the site of absorption of the poison, and that the excretion of carbon dioxide there reduces the pH value and thus the local concentration of un-ionized ammonia; the less carbon dioxide originally present in solution the greater is the reduction in concentration of un-ionized ammonia at the gill. The quantitative relation between the carbon dioxide content of the test solutions and the toxicity of ammonia supports this hypothesis. (Auth. abst.)

4173. Moreland, J. 1958. THE COMPOSITION, DISTRIBUTION AND ORIGIN OF THE NEW ZEALAND FISH FAUNA. Proc. New Zealand Ecol. Soc. 6. 28-30. 1958 (1959); Biological Abstracts, Vol. 36, No. 1, Abst. No. 312, 1960.

In considering the origin of the shore fishes it is clear that more than 75% of the species belong to typically Indo-Pacific families probably derived from the northwest by way of the southward extension of warm water along the Queensland and New South Wales coast. The endemic fauna as it exists today probably represents remnants of a number of successive invasions in earlier warm periods. Many of these elements appear to be phylogenetic and geographic relicts. The remaining elements of the shore fauna are largely south temperate in character with relatives in southeast Australia and southern South America, although emphasis is with South America. (Auth. abst.)

4174. Sequin, Rosemarie T. 1959. WEAKFISH EGGS. Estuarine Bull. 4(2): 3-5; Biological Abstracts, Vol. 36, No. 1, Abst. No. 319. 1961.

Changes of ovary and eggs which take place while the eggs are still within the ovary are described. (Auth. abst.)

4175. Balon, Eugeniusz. 1959. SPAWNING OF LEPOMIS GIBBOSUS (LINNE 1758) ACCLIMATIZED IN THE BACK WATERS OF THE DANUBE AND ITS DEVELOPMENT DURING THE EMBRYONIC PERIOD. (LAB. RYBARSTVA SLOVENSKEJ AKAD. VIED, BRATISLAVA, CZECHOSLOVAKIA.) (NERES LEPOMIS GIBBOSUS (LINNE, 1758), AKLIMATIZOVANEJ V BACNYCH VODACH DUNAJA A JEJ VYVOJ POCAS EMBRYONALNEJ PERIODY.) Vest. Cesk. Spol. Zool. 23(1): 1-22; Biological Abstracts, Vol. 36, No. 1, Abst. No. 1663. 1961.

L. gibbosus (pumpkinseed sunfish) was studied in Lake Lion, a former back water of the Danube near Cicov in Slovakia. The morphological and ecological characteristics of embryonic development are described in detail. In Lake Lion, L. gibbosus spawned from May 25-June 20. Most nests were built in colonies or in groups of 2 or 3. Immediately after hatching the prelarvae of Lepomis swim vigorously near the bottom where conditions for respiration and protection against enemies are good. For the next 4-5 days prelarvae lie on the bottom for most of the time. The male seems to watch the nest only before hatching. This species fills its swimming bladder before beginning to provide food for itself. Shortly afterwards the oil globule is resorbed and the fish adapts itself to exogenous food. Embryonic res-

piratory organs are weak in L. gibbosus and the embryonic blood vessel system resembles that of some species of the family Percidae. The distribution of L. gibbosus in the Danube apparently confirms the observation that this species can produce only in clean waters with clay or gravel on the bottom and under good O_2 conditions. At the time when prelarvae make the transition to exogenous food there must be available a large number of small micro-organisms. This fact seems to influence their choice of a suitable biotope for reproduction. Dimensions are reported for the following: (1) the ratio between diameter of the egg membrane and the diameter of the yolk sac; (2) the ratio between the diameter of the oil globule and the diameter of the yolk sac; and (3) the ratio between the height of the blastodisc and the diameter of the yolk sac. A comparison with other species is made for these quantities. The role of the oil globule as a hydrostatic organ is discussed. (MDS)

4176. Bauza Rullan, Juan. 1960. CONTRIBUTION TO THE KNOWLEDGE OF FISH OTOLITHS. (CONTRIBUCION AL CONOCIMIENTO DE OTOLITOS DE PECES.) Bol. R. Soc. Espanold Hist. Nat. Biol. 57: 89-98; Biological Abstracts, Vol. 36, No. 1, Abst. No. 2968. 1961.

Descriptions and photographs are given of otoliths of 2 spp. of Callionymus and 1 each of Sphyraena, Batrachus, Cephalacanthus, Germo, Helicolenus, Lichia, Ammodytes, and Lepidopus. (Auth. abst.)

4177. Bauza Rullan, Juan. 1960. CONTRIBUTION TO THE KNOWLEDGE OF FISH OTOLITHS. (CONTRIBUCION AL CONOCIMIENTO DE OTOLITOS DE PECES.) Bol. R. Soc. Espanola Hist. Nat. Biol. 57: 99-118; Biological Abstracts, Vol. 36, No. 1, Abst. No. 2969. 1961.

Descriptions and photographs are given of otoliths of 2 spp. of Rhombus, 2 of Lepidorhombus, 2 of Pleuronectes, 2 of Pegusa, and 1 each of Microstomus, Glyptocephalus, Monochirus, and Quenselia. (Auth. abst.)

4178. Kennamer, Earl F. 1960. WILD-LIFE RESOURCES OF ALABAMA'S PIEDMONT. Jour. Alabama Acad. Sci., Vol. 31, No. 4, pp. 258-291; Biological Abstracts, Vol. 36, No. 2, Abst. No. 3082. 1961.

Terrain and flora of the Piedmont Region are particularly suited to development of whitetail deer, eastern wild turkey, gray squirrels, and for construction of farm fish ponds. The region also supports significant numbers of bobwhite quail, cottontail rabbits and beavers. Low natural fish production of rivers and large impoundments is probably due to excessive muddiness of water by erosion of clay soils, fluctuation of water levels in large impoundments and lack of nutrients in the waters. (J. C. O'K.)

4179. Liebmann, Hans. 1958-1960. HANDBOOK OF FRESHWATER AND WASTE WATER BIOLOGY (HANDBUCH DER FRISCHWASSER- UND ABWASSER-BIOLOGIE.) Vol. II, Pts. 1-6 xi+960p.; Biological Abstracts, Vol. 36, No. 2, Abst. No. 3394. 1961.

This volume is concerned with the application of the methods for the investigation of water presented in Volume I. It is intended for use by advanced students, as well as to be a practical guide for those professionally engaged in occupations dealing with water supply, fish conservation, public health, etc. In the first section, the physical, chemical and biological factors involved in the natural purification of water are considered. The second deals with the biology of standing waters (natural and artificial lakes, dams, ponds and bogs) and of flowing waters (brooks and rivers) and the effects of sewage contamination upon their natural populations. The fifth section is devoted to waters inhabited by fish, and to means of protecting the fish and increasing the supply. The last two sections are concerned with waters polluted by sewage and other wastes. The last section (written with the collaboration of Dr. H. A. Stammer of Munich) concentrates on the toxicology of sewage, its oxygen deficiency, inorganic and organic poisons, and the effects of these upon aquatic plants, fish and other animals. (M.S.G.)

4180. Moroni, Antonio. 1960. PLAN AND METHODS FOR A SYSTEMATIC STUDY OF THE LAKES OF THE NORTHERN SLOPE OF THE NORTHERN APPENNINES (COLLE DI CADIBONA-BOCCA SERRIOLA). (PIANO E METODI PER UNO STUDIO SISTEMATICO DEI LAGHI DEL VERSANTE N. DELL'APPENNINO SETTENTRIONALE (COLLE DI CADIBONA-BOCCA SERRIOLA).) Boll. Pesca, Piscicolt. e Idrobiol. 14(1): 44-58; Biological Abstracts, Vol. 36, No. 2, Abst. No. 3395. 1961.

Studies of the geographical and biological character of Italian lakes have been reviewed, with special reference to the little-studied basins of the northern Appennines. Taking as a starting point the basins of the rivers that flow into the River Po or into the Adriatic Sea, the whole northern slope of the northern Appennines (Colle di Cadibone, Bocca Serriola) is divided into 25 sections of study. A lake of the Appennines is defined as a mass of stagnant water gathered into a basin, not subject to drainage, and without strict limits as to depth and area. The method of investigation is divided into three sections: cartographic and bibliographic study, field work, and analysis of geographical, geological and biological data. (From auth. summ.)

4181. Frank, Stanislav. 1959. CONTRIBUTION TO THE GROWTH OF THE COMMON BROWN TROUT (SALMO TRUTTA M. FARIO L.) IN KLICAVA VALLEY RESERVOIR. (PRISPEVEK K RUSTU PSTRUHA OBECNEHO F. POTOCNI (SALMO TRUTTA M. FARIO L.) V KLICAVSKE UDOLNI NADRZI.) (English summary) Vest. Ceskoslov.Spol. Zool, Vol. 23, No. 2: pp. 123-130; Biological Abstracts, Vol. 36, No. 2, Abst. No. 3399. 1961.

The rate of growth has been determined for 14 trout. For computing the average calculated length the method of R. Lee was used with the constant 25 mm for the time of scale formation. Weight in pre-

vious years of life was determined by the logarithmic method of Monastyrskij, modified by Tjurin. The rate of growth of trout in the Klicava Valley Reservoir was very rapid. In older specimens most of the scales were regenerated. (MDS)

4182. Moriyama, Hideo, and Hiroshi Ueno. 1959. FISH-KILLING FACTOR PRODUCED BY PROTEUS VULGARIS. I. STUDIES ON THE PRODUCTION OF THE TOXIC FACTOR. Japanese Jour. Microbiol., Vol. 3, No. 1, pp. 105-112; Biological Abstracts, Vol. 36, No. 2, Abst. No. 3406. 1961.

Studies were made using Japanese killifish. The fish died when they were kept in water in which various protein substances had been dissolved. Death was related to the growth of Proteus vulgaris in the water, but the bacteria themselves had no toxic action. Some toxic factor produced by the bacteria resulted in the death of fish. The toxic factor production was not directly proportional to the degree of bacterial growth. Various amino acids gave no support to toxic factor production. Some decomposition product of protein, probably some polypeptide, appeared to be changed into the toxic factor by the action of the bacteria. The toxic factor was produced sooner and to a greater degree as the peptone or polypeptide concentration was increased in water. (Auth. abst.)

4183. Spaas, J. T. 1960. CONTRIBUTION TO THE COMPARATIVE PHYSIOLOGY AND GENETICS OF THE EUROPEAN SALMONIDAE. III. TEMPERATURE RESISTANCE AT DIFFERENT AGES. Hydrobiologia 15(1/2): 78-88; Biological Abstracts, Vol. 36, No. 2, Abst. No. 3408. 1960

The temperature resistance, measured by the ultimate upper lethal temperature, was determined for the alevin, fry and parr of salmon, sea trout and brown trout. The temperature resistance increases with age from alevin to parr stage. The individual temperature resistance of the yearlings is in each form positively correlated with the individual length and weight. The salmon is characterized by a higher temperature resistance from the trout but there was no significant difference between sea and brown trout. The ecological distribution does not match the experimental classification with respect to thermal adaptation. (K. E. M.)

4184. Fuse, S. I., T. Habe, E. Harada, R. Okuno, and T. Miura. 1959. THE ANIMAL COMMUNITIES IN THE SUBMERGED MARINE PLANT VEGETATIONS. Bull. Marine Biol. Sta. Asamushi, Tohoku Univ. 9(4): 173-175; Biological Abstracts, Vol. 36, No. 2, Abst. No. 6460. 1961

While certain fish are characteristic inhabitants of Zostera beds or of the Sargassum belt on rock, others dwell in Zostera only as subadults March-June. Rockfish Sebastes inermis illustrates such seasonal appearance in Zostera, with later migration to Sargassum. (H. W. W.)

4185. Sacchi, C. F. 1959. ENVIRONMENTAL CHANGES FOLLOWING THE PERMANENT INFLOW OF MARINE WATER IN THE LAKE OF PATRIA. (VIVIFICAZIONE MARINE PERMANENTE E MUTAMENTI AMBIENTALI NEL LAGO DI MARINE WATER IN THE LAKE OF PATRIA.) Natura (Milan) 50(2): 43-56; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6470. 1961.

This small lake on the Italian coast north of Naples has been recently in communication with the sea through an artificial canal; the continuous inflow of salt water has greatly influenced the fauna. The groups considered are: Polychaeta, Crustacea, Insecta, Gastropoda and Lamellibranchiata. Fresh-water species have disappeared and many of the environments of the lake have been colonized by euryalin forms. (M. M.)

4186. Hohnk, Willy. 1958. MYCOLOGICAL WASTE-WATER STUDY II. (MYKOLOGISCHE ABWASSER-STUDIE II.) Veroffentl. Inst. Meeresforsch. Bremerhaven 5(3): 211-256; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6472. 1961.

It was determined that fungi colonizing a water-course can indicate the amount of waste-water present. The lower courses of the Hunte and the Geeste, 27 and 9 km long respectively, were studied. Both carry household, bog and industrial waste-water. Results are reported in lists of species and tables of finds, the latter being illustrated by spectra. They are summarized for individual localities, trips, and sections of the river. The locality spectra parallel hydrographic determinations and still exhibit peculiarities in the water-course. The most important criterion for waste-water pollution lies in the number of Fungi imperfecti and organisms of illuvia. If these two groups make up 50% or more of the total fungi, then pollution is considerable. Unpolluted courses have significantly smaller concentrations. If Saprolegniaceae and Pythiaceae (both sexual and asexual) are abundantly represented, it is a favorable indication. Cytridiales is always and Pythia usually present. The Saprolegniaceae are often missing under very polluted conditions. Increasing pollution decreased the number of sexual forms and mydelia in Pythiaceae and Saprolegniaceae and leads to their absence. The process of increasing pollution is also paralleled by a decrease or impoverishment of Phycomycetes. The moderately warm summer of 1957 favored sexual species of the Oomycetes more than the cooler months. Areas of the Geeste investigated were more polluted than those of the Hunte. Weser water, close to the mouth of the Hunte, is less polluted than that of the Hunte. The same may be said of the Geeste, but in the Weser the strongly selective influence of brackish water plays a significant role. (MDS)

4187. Franco, G. T. 1959. A PRELIMINARY NOTE ON THE FOOD OF CERTAIN BRAZILIAN FISH OF COMMERCIAL VALUE. (NOTA PRELIMINAR SOBRE A ALIMENTACAO DE ALGUNS PEIXES COMERCIAIS BRASILEIROS.) An. Acad. Brasil. Cienc. 31(4): 589-593; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6486. 1961

The major foods of such commercial fish as Sardinella allecia, Opisthenema oglinum, Macrodon

ancylodon, Cynoscion striatum, Nebris microps, Cynoscion leiarchus, Micropogon ondulatus, M. furnieri, Corniva chora-chora (Umbrina broussonetti), Menticirrhus americanus, Betara riscada Larimus breviceps and Bairdiella ronchus have been determined on the basis of the examination of the stomach contents of large numbers of specimens. The food varied from decapods, through crustacea, ophiuroids and polychaetes to small fishes for the larger varieties, and to microcrustacea, copepods and both benthic and pelagic diatoms for the sardine types. (A. C. W.)

4188. Furukawa, Ichiro. 1959. ECOLOGICAL STUDY ON THE FATNESS OF WHITE MARLIN IN THE EAST SEA. (In Japanese with English summ.) Bull. Fac. Agric. Univ. Miyazaki 4(2): 216-221; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6489. 1961

White marlin migrate to the East Sea in search of food after spawning and constitute a homogeneous population. Two groups determine the seasonal variation of average values of fatness. The group with the greater fatness remains throughout the winter, the group with less fat migrates after spawning. Fatness (K) is related to body length (L) by the formula $K = 10.9387 + 0.2048L - 0.0011L^2 - 0.0006L^3$. Fish over 185 cm reach their minimum fatness in May and Maximum in December. Fish below 185 cm reach their minimum fatness in August and September and maximum in December. (MDS)

4189. Gilhousen, Philip. 1960. MIGRATORY BEHAVIOR OF ADULT FRASER RIVER SOCKEYE. In: International Pacific Salmon Fisheries Commission Progress Report. International Pacific Salmon Fisheries Commission: New Westminster, B. C., Canada. 1960. p. 1-78; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6490. 1961

Variable migratory behavior of adults of Fraser River sockeye races was analyzed to assist in designing regulations for the fishery. Unusually large diversions of sockeye through Johnstone Strait were associated with unusual oceanographic conditions and with sunspot maxima. Variable migration timing of the Adams River race and of other sockeye races is illustrated and possible relationships with abundance of sockeye and with the phase of the moon are noted. Variations in the upriver migrations of Adams River sockeye are related to variable Fraser discharge in the summer. It is suggested that timing of migration and spawning are a consequence of maturation, which is photoperiodically controlled, and that photoperiodism may be involved in variable timing. (Auth. abst.)

4190. Houser, Alfred. 1959. THE EFFECT OF HOMING ON CHANNEL CATFISH POPULATION ESTIMATES IN LARGE RESERVOIRS. Proc. Oklahoma Acad. Sci. 40. 121-133; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6495. 1961.

A mark-and-recapture fish population estimate on Fort Gibson Reservoir produced an estimate for channel catfish which was considered too small and homing was suspected. A second estimate was conducted on Lake Lawtonka in which 1002 channel catfish were tagged and released at a point near the center of the lake. During the 33 days of fishing 96 tagged fish were recaptured and 37 had returned to their home station. Population estimates were calculated by the Schnabel, Schumacher and Eschmeyer, and Latta methods disregarding the homing effect. An assumption was made that the homing seen in tagged fish returns represented an error which could be removed in the estimate by adjusting the number of recaptured fish. Subtracting the catchabilities of homing fish from that determined for all fish combined resulted in a new catchability from which an adjusted number of recaptures was obtained. Using this adjusted number of recaptures to calculate the estimate by the Latta method, yielded a higher estimate which compensated for the homing effect. (Auth. abst.)

4191. Jen, Y. F., and M. K. Hsu. 1958. FACTORS INFLUENCING APPLICATION OF COPPER SULFATE AND FERROUS SULPHATE AS A PARASITICIDE IN PONDS. Acta Hydrobiol. Sinica 1958: 1-8; Biological Abstracts, Vol. 36, No. 3, Abst. No. 9496. 1961

A mixture of copper sulphate and ferrous sulphate in 5:2 ratio with a total concentration of 0.7 ppm has been used extensively for control of some parasitic organisms on gills of Chinese pond fish, Ctenopharyngodon. Its effect is sometimes decreased or even entirely lost in cold seasons, and in some particular fish-ponds. The possible explanation is that decrease in temperature, and precipitation of cupric ions, together with formation of relatively non-toxic complexes, would affect toxicity of mixture. For adjusting concentration of mixture, an empirical formula has been derived by the authors. In practice, after pH, organic-matter content as well as temperature of water in a pond have been determined, concentration of copper sulphate necessary to provide effective concentration lethal to parasites, but non-toxic to fish, can be calculated. The formula is derived empirically, but some modifications may still be necessary in particular cases.

4192. Riggs, Carl D., and George A. Moore. 1959. GROWTH OF YOUNG GAR (LEPISOSTEUS) IN AQUARIA. Proc. Oklahoma Acad. Sci. 40: 44-46; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6508. 1961.

Lengths and weights of 5 longnose gar (L. productus), kept individually in 10-gallon aquaria and fed regularly on live fish, were measured 6 times during a 25-day period, July 25 to August 19, 1957. Total-lengths of the L. osseus averaged 257 mm on July 25; for L. productus 211 mm. The average daily increment in length was 3.2 mm (range: 2.3 to 4.5) for L. osseus, and 1.7 mm (range: 1.4 to 2.1) for L. productus. Average daily weight increment were 1.8 g (1.3-2.3) and 1.0 g (0.7-1.3) respectively. Growth of these experimental fish corresponded very well with that of fish taken from Lake Texoma during and at the end of the experiments. (Auth. abst.)

4193. Sandoz, O'Reilly. 1959. FISH POPULATIONS OF FOUR PONDS AND TWO LAKES TWO YEARS

AFTER REHABILITATION BY ROTENONE TREATMENT. Proc. Oklahoma Acad. Sci. 40. 137-143; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6510. 1961.

Fish populations in 4 ponds and 2 lakes were studied 2 years after treatment with rotenone. One of these bodies of water was poisoned during the re-examination and others were sampled by using short-term mark-and-recapture methods with wire traps. In all cases the standing crop in pounds per acre had decreased 2 years after treatment. Reduction in predominance of certain non-game species and general improvement of angling was characteristic of most bodies of water in this study. (Auth. abst.)

4194. Sandoz, O'Reilly. 1959. SUGGESTIONS FOR CONDUCTING PRE-IMPOUNDMENT FISHERY SURVEYS. Proc. Oklahoma Acad. Sci. 40. 144-147; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6511. 1961.

A method is suggested for predicting the future potential of a reservoir by the use of existing topographic, geologic, pedologic, climatologic, hydrologic and reservoir-operation data. The interactions of these phenomena are examined from the point of view of fishery ecology and human use. (Auth. abst.)

4195. Tanaka, Syoiti. 1958. A MATHEMATICAL CONSIDERATION OF THE EFFECT OF MORTALITY AND GROWTH ON A FISH POPULATION. (In Japanese with English summ.) Bull. Tokai Reg. Fish. Lab. 20. 1-12; Biological Abstracts, Vol. 36, No. 3, Abst. No. 6519. 1961.

Baranov and many others have tried to formulate fishing mortality on the basis of various mathematical models. However, little attention has been paid to evaluating the other terms in the equation; this is attempted with present paper. When fishing intensity is reduced, population will increase in size mostly due to the increase in old fish. Then if the reproduction potential remains on a constant level, the productivity of the population comprising numbers of old fish would possibly be less than that of a smaller population consisting mainly of young fish. Thus; we are able to suggest a favorable age composition that gives a better yield, and a step for controlling the selective pattern of fisheries to secure such an age composition. (From auth. summ.)

4196. Mandossian, Adrienne, and Robert T. McIntosh. 1960. VEGETATION ZONATION ON THE SHORE OF A SMALL LAKE. Amer. Midland Nat. 64(2): 301-308; Biological Abstracts, Vol. 36, No. 8. Abst. No. 23125. 1961.

Quantitative sampling by means of transects on sand and muck bottoms on a recently exposed shoreline is used to study the composition and apparent zonation. The first four meters on both substrates are dominated by the same species. Beyond this the composition becomes increasingly unlike. The apparent zones are physiogonomic and are not differentiated into bands on the basis of species composition. (Auth. abst.)

4197. McAllister, D. E. 1960. LIST OF THE MARINE FISHES OF CANADA. Natl. Mus. Canada Bull. 168. 1-76; Biological Abstracts, Vol. 36, No. 3, Abst. No. 9262. 1961.

This list records all spp. of fish recorded as occurring in the brackish and marine waters of Canada. In general, only fishes of the continental shelf and offshore fishing banks are listed. The classification follows Berg (1940) with some modifications. Names are listed alphabetically under the family or subfamily, with scientific name, common name, if any, indication of general distribution, and references to the bibliography, which lists over 250 titles. A total of 535 spp. is listed, of which 260 spp. are Pacific, 107 Arctic, and 259 Atlantic in their distribution. The family Cottidae has the most spp. in the Pacific and Arctic, and Gadidae in the Atlantic.

4198. Guryanova, E. F. 1957. SEA HYDROBIOLOGY IN CHINA. Vestn. Akad. Nauk SSSR 1957 (1): 74-77; Biological Abstracts, Vol. 36, No. 4, Abst. No. 9364. 1961.

Study of marine fauna and flora in China is conducted in 4 main areas: systematic recording of marine resources of the republic; a study of the ecology and biology of the most important industrial species; development of breeding methods of invertebrates and algae under natural conditions; technological development of obtaining industrially important substances and food products from non-fish sea resources. Opening of 6 new marine biostations is planned. There are 190 schools of higher learning and 18 universities where biology is taught; each university prepares specialists in a particular field.

4199. Anonymous. 1960. RESEARCH WORK BY OFFICERS OF THE NATIONAL MUSEUMS OF CEYLON FROM 1925 TO 1960. Spolia Zeylanica 29(1): 135-147; Biological Abstracts, Vol. 36, No. 4, Abst. No. 9395. 1961.

A bibliography is given of about 460 publications, by 14 different authors, of which 323 are works of P. E. P. Deraniyagala, Director of the Natl. Museums, on many different subjects, including taxonomy of many marine forms.

4200. Pritchard, Austin W., David E. Kerley, and Alan G. Heath. 1960. FILTER FOR RUNNING-WATER SYSTEMS IN THE LABORATORY. Turtox News 38(8): 210-211; Biological Abstracts, Vol. 26, No. 4, Abst. No. 9418. 1961.

Chlorine is removed from water by passing through a filter made from a gallon jar filled with oyster shells, activated charcoal, and glass wool. Water is forced through under pressure. (R. W. D.)

4201. Bursche, Eva-Maria. 1959. INVESTIGATIONS OF THE DETRITUS CONTENT OF LAKES AND RIVERS. (UNDERSUCHUNGEN UBER DEN DETRITUSGEHALT IN SEEN AND FLUSSEN.) Internatl. Rev. Ges. Hydrobiol. 44(3): 439-448; Biological Abstracts, Vol. 36, No. 4, Abst. No. 9700. 1961.

Detritus and phytoplankton volumes were measured quantitatively by use of an ocular micrometer. In 5

eutrophic lakes that were examined the volume of the detritus throughout the year was always only a small fraction of the phytoplankton volume. In the tidal waters at the mouth of Elbe and Weser Rivers, however, the detritus volume far exceeded that of the phytoplankton. It is believed that in lakes the detritus contributes very little to production. (C. C. D.)

4202. Edelman, Isidore S., Ho Lee Young, and John B. Harris. 1960. EFFECTS OF CORTICOSTEROIDS ON ELECTROLYTE METABOLISM DURING OSMOREGULATION IN TELEOSTS. Amer. Jour. Physiol. 199(4): 666-679; Biological Abstracts, Vol. 36, No. 4, Abst. No. 10297. 1961.

The effects of injections of hydrocortisone, 9 a fluorohydrocortisone and d, l aldosterone on rates of loss of Na and K and on serum and muscle electrolyte concentrations were studied in euryhaline and stenohaline marine teleosts during immersion in fresh water for periods of 1-16 hours. Survival time was not affected by administration of adrenal steroids. Survival in fresh water was inversely correlated to the rates of Na loss. Administration of corticosteroids had no consistent effect on either Na or K loss or on the changes in plasma or muscle electrolyte content during immersion in fresh water. It is inferred from the data that euryhalinity depends on the ability to conserve Na, K and Cl in hypotonic water and that NaCl depletion, extracellular fluid contraction and hypovolemia are major factors in the failure of marine teleosts to survive in fresh water.(Auth. abst.)

4203. Oztan, Nezihe, and Aubrey Gorbman. 1960 THE HYPOPHYSIS AND HYPOTHALAMO-HYPOPHYSEAL NEUROSECRETORY SYSTEM OF LARVAL LAMPREYS AND THEIR RESPONSES TO LIGHT. Jour. Morphol. 106(3): 243-261; Biological Abstracts, Vol. 36, No. 4, Abst. No. 10429. 1961

An histological and cytological study was made of the pituitary glands and hypothalamic neurosecretory apparatus of ammocoetes of various sizes of Petromyzon marinus and Entosphenus lamottei, and of metamorphosing Entosphenus. The rostral zone of the pars distalis contains chromophobes, basophils, and rare acidophils. The proximal pars distalis is chromophobic. The cells of the pars intermedia stain with aldehyde fuchsin and PAS, but not with aniline blue. The neurohypophysis of all sizes of larvae is filled with neurosecretory material. There are two hypothalamic neurosecretory centers which, together, form an almost continuous arc from the preoptic region to the posterior margin of the neurohypophysis. The largest center, the preoptic, is the source of 4 groups of neurosecretion-bearing axones: (a) axones decussating near the optic tracts and terminating over the rostral pars distalis, (b) axones which are gathered into two preoptico-hypophyseal tracts which enter the neurohypophysis from an anterior direction, (c) axones which enter the neurohypophysis from a lateral direction without joining into tracts, (d) axones which proceed directly posteriorly to an undetermined termination. The more posterior neurosecretory center, over the infundibular posterior recess, has two types of axones: (a) a small group, apparently entering the neurohypophysis from a posterior and lateral direction, (a) a large group terminating in vascular connective tissue at the edge of the midbrain. Exposure of ammocoetes to continuous light caused a depletion of neurosecretory granules from cell bodies and axones of the preoptic nucleus; continuous darkness caused a strong accumulation of neurosecretory material in these places. Returning such animals to normal diurnal illumination led to a prompt recovery of a normal distribution of neuro-secretory material. Altering the external illumination had no apparent effect on the neurohypophysis or on adenohypophyseal cytology. (Auth. abst.)

4204. Svaetichin, G., W. Krattenmacher, and M. Laufer. 1960. PHOTOSTIMULATION OF SINGLE CONES. IN: MECHANISMS IN VISION. Jour. Gen. Physiol. 43 (6 Pt. 2): 101-114; Biological Abstracts, Vol. 36, No. 4, Abst. No. 10574. 1961.

A method of illuminating individual cones in the isolated functioning fish retina is described. The electrical response (L type) of the second order of retinal neurons has been recorded when one cone is being illuminated. In evoking a response in the second order of retinal neurons, the cones in the center of the area of convergence proved to have equal thresholds. The amplitude of the response evoked by stimulation of one cone was graded and proportional to the logarithm of the light intensity. The relationship between the amplitude of the response and the number of cones illuminated was also studied. The spatial summation of the synaptic effects of the cones was linear for a certain limited area, which was different for different species of fish. At the bipolar level no inhibitory interactions between the receptive fields were observed. (Auth. abst.)

4205. Ladiges, Werner. 1959. CONTRIBUTIONS TO THE KNOWLEDGE OF THE CICHLIDS OF LAKE TANGANYIKA. (BEITRAGE ZUR KENNTNIS DER CICHLIDEN DES TANGENJIKA-SEES. I.) Internatl. Rev. Ges. Hydrobiol. 44(3): 431-438; Biological Abstracts, Vol. 36, No. 4, Abst. No. 12464. 1961.

Large numbers of preserved and living cichlids of a number of genera and spp. were received at the Hamburg Zoological Museum. A list of 43 spp. is given, of which 14 were studied both in the preserved and living state. Four spp., namely Tropheus moorei Blgr., T. duboisi Marlier, Lamprologus Leleupi Poll, and L. compressiceps Blgr. are described and such of their ecology (food, breeding, territoriality, etc.) as could be observed in aquaria is discussed. (C. C. D.)

4206. Morrow, James E., Jr. 1959. ON MAKAIRA NIGRICANS OF LACPEDE. Postilla 39. 1-12; Biological Abstracts, Vol. 36, No. 4, Abst. No. 12467. 1961.

The identity of M. nigricans has long been a puzzle. Lacepede made his description from the notes and a sketch sent to him by MM. Traversay, Fleurian-Bellevue, and Lamathe, and from his published description and figure it has been impossible to identify the fish with any known sp. Recently, the author received photographs of the original sketch, on which there were notes as to dimensions. In writing his description, Lacepede made two errors in regard to the measurements. On the basis of correction of these points, and other details of the original notes, it is decided that the fish described was the form currently known as M. ampla, the Atlantic blue marlin. Since Lacepede's name has priority, the correct name becomes M. nigricans Lacepede (= Tetrapturus herschelii Gray = T. amplus Poey = M. perezi de Buen). This is the type sp. of the genus. The type specimen itself was eaten. The type material of the sp. is a sketch, accompanied by notes and measurements, now with the original manuscript of Histoire Naturelle des Poissons, vol. 8, by Cuvier and Valenciennes, in the library of the Museum National d'Histoire Naturelle, Paris.

4207. Williams, George C. 1960. DISPERSAL OF YOUNG MARINE FISHES NEAR WOODS HOLE, MASSACHUSETTS. Pup. Mus. Michigan State Univ. 1(10): 331-367; Biological Abstracts, Vol. 36, No. 4, Abst. No. 12471. 1961.

Waquoit Bay, a shallow, weedy body of salt water just inshore from the southern margin of Cape Cod, connects to Nantucket Sound through a narrow pass guarded by jetties. The rise and fall of the tide results in strong alternating flood and ebb currents between the jetties. Four spp. of fish are abundant in the bay and spawn there so that their young are present in large numbers during the summer. In order of their apparent numbers these are a stickleback (Apeltes quadracus), a pipefish (Syngnathus fuscus), a silverside (Menidia menidia), and a killifish (Fundulus heteroclitus). These species are characteristic of calm, weedy areas, and are rare, or absent, immediately outside the bay, where the bottom is of shifting gravel, free of vegetation, and washed by strong tidal currents. Young of these spp., if found in the tidal currents entering or leaving the bay, may therefore be regarded as emigrants to, or immigrants from, other areas of similar habitat conditions. Such exchanges seem to be extensive for the pipefish, moderate for the silverside, rare for the stickleback, and absent for the killifish. For the two most vagile spp., at least, there is probably no isolation of the bay populations in the genetic sense, even though they are spatially separated from other such populations as spawning adults. The immigrant young pipefish and silversides greatly exceeded the emigrants in both numbers and average size, despite their being much more abundant in the bay than outside. The author explains these observations by postulating that the young of both spp. are notivated at an early age to abandon their planktonic life and localize with respect to fixed environmental features, but that they are unable to do so in such areas as the northwestern part of Nantucket Sound, where tidal currents in excess of a meter per second are found. When carried into an area of calm water, however, they are able and inclined to resist further transport by tidal currents. Such calm waters as Waquoit Bay, therefore, have a much greater rate of immigration than of emigration of the new year-classes. Other areas, where currents are strong enough to remove the young, but not so strong that the adults cannot maintain themselves, would presumably provide an excess of emigrants over immigrants received. Similar observations, except that there was little difference between the rates of immigration and emigration, were made at Cape Poge Bay, on Chappaquidick Island, which likewise connects to Nantucket Sound through a narrow channel. (Auth. abst.)

4208. Bogorov, B. G. 1959. ON THE STANDARDIZATION OF MARINE PLANKTON INVESTIGATIONS. Internatl. Reb. Ges. Hydrobiol. 44(4): 621-642; Biological Abstracts, Vol. 36, No. 5, Abst. No. 12858. 1961.

The importance of standardizing quantitative plankton methods is emphasized, in order that comparisons among various studies might be more meaningful. It is recommended that preserved water samples of 1-5 liters be taken for phytoplankton, to be followed by settling or by filtration through membrane filters. Small zooplankters are best collected by means of a plankton sampler with walls of silk netting, and with a capacity of 25-50 liters. Medium sized plankters can be collected best by closing Juday nets hauled through definite strata. A larger closing net with coarser mesh, but with many of the good features of the Juday net is thought to be best for macroplankton and fish eggs. Recommendations are made also for studies of primary production by the oxygen and C^{14} methods. Uniform treatment of data also is very important. Quantitative estimates of biomass (wet weight, or dry weight) are more significant than numbers or frequency of occurrence. Tables of the biomass of various specific plankters are given. (C. C. D.)

4209. Lackey, J. B. 1960. KNOW YOUR INDICATOR ORGANISMS! Water Wks Engng, 113, 30-32; Water Pollution Abstracts, Vol. 34, No. 1, Abst. No. 64, 1961.

Organisms occurring in raw water which can be used to indicate its quality are described, and some of them are illustrated. The author emphasizes that the quality of water can be assessed by a knowledge of the conditions existing when a certain organism is present. As soon as a particular organism, indicating a deterioration in quality, is observed, remedial action and preventive measures can be taken.

4210. Kibalchich, I. A., I. M. Belova, E. S. Brook, I. N. Sosunova, A. I. Gutkovskaya, Yu. A. Jakov, and T. Z. Timofeeva. 1960. SANITARY ASSESSMENT OF THE CONSEQUENCES RESULTING FROM THE FLOODING OF TREE VEGETATION DURING PREPARATION OF WATER RESERVOIR BEDS. Hyg. & Sanit., Moscow, 25, No. 1, 15-20 (English summ.);

Water Pollution Abstracts, Vol. 34, No. 1, Abst. No. 65. 1961.

Investigations were carried out on the large Kuibishev and Kamsk reservoirs, U.S.S.R., to determine the effect on the quality of the water of the trees, shrubs, and other vegetation which were left intact on the ground which was to form the bed of the reservoirs when they were flooded. No unfavourable effects on the quality of the water were found. In working out the series of measurements for the clearing of tree vegetation before the formation of a reservoir, the authors point out the necessity of considering the ratio between the volume of the water in the reservoir and that of the organic matter to be flooded, the rate of flow of the water out of the reservoir, the existence of shallow water areas, and the climatic conditions.

4211. Sladecek, V., L. Fiala, and A. Sladeckova. 1959. LIMNOLOGICAL INVESTIGATIONS IN THE PASTVINY RESERVOIR WITH SPECIAL REFERENCE TO THE EFFECT OF A POWER STATION. Sci. Pap. Inst. chem. Technol., Prague, Fac. Technol. Fuel Wat., 1959, 3, Part 2, 431-595; Water Pollution Abstracts, Vol. 34, No. 1, Abst. No. 78. 1961.

After a survey of the results of investigations into the condition of the water in reservoirs of Czechoslovakia and other countries, the author describes investigations into the condition of the Pastviny reservoir between 2 and 12 July 1957, in which the effect of the peak activity of a power station was studied. The reservoir is fed by an unpolluted mountain stream so that conditions are not complicated by pollution and processes of self-purification. By the regular withdrawal of large amounts of water a second thermocline is formed between the lower and middle layers of the hypolimnion. New water enters in the metalimnion. The lower layers of the hypolimnion are practically not moved and stagnate so that an anaerobic hypolimnion, characterized by high contents of iron and manganese, is formed in the oligotrophic reservoir. This is due entirely to the vertical position of the run-off of the turbines. Details are given of the vertical and horizontal distribution of organisms and of the chemical composition of the water. The practically oxygen-free layer of the lower hypolimnion could be got rid of only by opening the ground sluices, which for economic reasons is not done. The author suggests that flood water might be allowed to run off through the ground sluices which would improve conditions at least temporarily.

4212. Remane, A., and C. Schlieper. 1958. THE BIOLOGY OF BRACKISH WATERS. Binnengewasser, 22. 348 pp.; Water Pollution Abstracts, Vol. 34, No. 2, Abst. No. 240. 1961.

The general ecology of brackish waters is dealt with by Remane who describes the formation of brackish waters, conditions of life, brackish water organisms, the penetration of freshwater and marine plants and animals, the types of habitat, and the different types of brackish water (seas, lakes, estuaries, and ponds). In the second part Schlieper deals with physiological peculiarities and problems of life in brackish water.

4213. Mann, H. 1958. WATER CONTROL AND FISHERIES. Taschenbuch der Wasserwirtschaft, 603-616; Water Pollution Abstracts, Vol. 34, No. 2, Abst. No. 352. 1961.

The author discusses, from the point of view of fisheries, the importance of maintaining the natural condition of waters. Precautions to be taken in water engineering works, especially with reference to the maintenance of breeding places, are discussed. A section is devoted to the maintenance of fish in dams and reservoirs. The effect of industrial waste waters and the use of sewage in fishponds are considered.

4214. Anonymous. 1959. HARMFUL TO FISH? Canad. Pulp Pap. Ind., 12, No. 5, 22; Water Pollution Abstracts, Vol. 34, No. 1, Abst. No. 353. 1961.

The common practice of discharging large quantities of settled sludge from conventional water-treatment sedimentation tanks to rivers has been questioned recently by certain authorities, and tests have therefore been conducted to determine whether the aluminium hydroxide present in the sludge is harmful to fish. A pilot plant was constructed by the Northwest Filter Company at Seattle, Wash., to treat water from the Duwamish river by conventional coagulation with alum and sedimentation; details of the tests, in which young salmon were introduced into the tanks while the sludge was settling, are given. It is concluded, from the study, that the aluminium hydroxide sludge does not have any adverse effects on fish life.

4215. Trama, F. B., and R. J. Benoit. 1960. TOXICITY OF HEXAVALENT CHROMIUM TO BLUEGILLS. J. Wat. Pollut. Contr. Fed. 32, 868-877; Water Pollution Abstracts, Vol. 34, No. 2, Abst. No. 356. 1961.

Studies carried out by various workers on the toxicity of chromium to fish have given very variable results, largely because the tests have been carried out under a wide range of conditions. The authors describe experiments which they have carried out on the toxicity of chromate and dichromate. Experimental procedure is described. It was found that the 96-hour TL_m for bluegills in soft water is about 110 mg of chromium, as dichromate, per litre, and 170 mg as chromate; the reasons for this difference are discussed. The 24-hour TL_m in soft water is between 175 and 225 mg of chromium per litre. The toxicity of chromium is considerably reduced by increase in alkalinity and hardness, and it is stressed that the alkalinity of the receiving water should be considered as well as the available dilution when the disposal of waste containing hexavalent chromium is planned.

4216. Liepolt, R., and E. Weber. 1958. THE TOXIC ACTION OF COPPER SULPHATE ON WATER ORGANISMS. Wass. u. Abwass., 1958, 335-353; Water Pollution Abstracts, Vol. 34, No. 2, Abst. No. 358. 1961.

The author describes tests on the toxicity of dissolved copper to rainbow trout, minnows, and various fish-food organisms, with special reference to the effects of hardness, temperature, and pH value. Tables of results show the limits of toxicity to the various animals; sensitivity is more easily compared by the rapidity of action. The symptoms of poisoning shown by the various test animals are described. Toxicity at high temperatures and in soft water was considerably greater than at low temperatures and in hard water. Copper sulphate remains in solution to a greater extent in acid water and is thus more toxic. No effect was observed in fish when copper was taken by mouth.

4217. Paasche, E. 1960. ON THE RELATIONSHIP BETWEEN PRIMARY PRODUCTION AND STANDING STOCK OF PHYTOPLANKTON. Journal Du Conseil, Vol. XXVI, No. 1, pp. 33-48.

Phytoplankton samples collected in Atlantic water in the Norwegian Sea in June 1954, were worked up according to the sedimentation method. Standing stock size was expressed in terms of cell surface area as well as of cell number and cell volume. Production capacities had been determined by Berge, using his modification of the ^{14}C method.

Using log-transformed data on standing stock and production capacity, regressions and correlations were calculated for surface samples.

The observed relationships between standing stock size and production capacity agreed well with similar observations by earlier authors.

The results supported the hypothesis that the total cell surface area of plankton communities rests more evenly on all size categories of plankton algae than do either total cell volume or total cell number. However, it was not possible to produce conclusive statistical evidence that cell surface area is the most adequate measure of standing stock of primary producers.

On the basis of data presented by various investigators, it was demonstrated that the chlorophyll content per unit of cell surface area in a number of phytoplankton species is more nearly constant than chlorophyll per volume unit or per cell.

The low division rate of large diatoms was tentatively explained as resulting from a continual expenditure of energy in the maintenance and reproduction of the vacuole. (Auth. summ.)

4218. Sorokin, J. I. 1960. VERTICALDISTRIBUTION OF PHYTOPLANKTON AND THE PRIMARY ORGANIC PRODUCTION IN THE SEA. Journal Du Conseil, Vol. XXVI, No. 1, pp. 49-56.

The dependence of the vertical distribution of the living phytoplankton on thermal-density stratification was investigated in the Atlantic by the ^{14}C method.

It was found that in the absence of stratification the vertical distribution of phytoplankton is more or less homogenous and depends to some extent on submarine illumination.

In the presence of stratification in the euphotic zone phytoplankton tends to accumulate in the upper part of the thermocline.

Thus the rate of primary production at different depths depends not only on the submarine illumination but also on thermal stratification. Before samples are taken for primary production work it is necessary to measure the thermal stratification and to determine the position of thermocline. (Auth.)

4219. Holden, M. J. 1960. EVIDENCE OF COD (GADUS MORHUA L.) MIGRATIONS FROM THE NORWAY COAST TO THE FAROESE ISLANDS. Journal Du Conseil, Vol. XXVI, No. 1, pp. 69-72.

Two pairs of otoliths from cod caught at the Faroes were found to have a structure similar to that of Arcto-Norwegian cod otoliths and dissimilar to that of Faroese cod otoliths. It is concluded that the fish originated from the Arcto-Norwegian stock.

The path of movement between the two regions is discussed. It is shown that it most probably lies in the anti-clockwise current gyral in the Greenland Sea and that there is a drift with the currents from Spitsbergen via Jan Mayen and northeast Iceland to the Faroes. (Auth. summ.)

4220. Strasburg, Donald W., and Heeny S. H. Yuen. 1960. PROGRESS IN OBSERVING TUNA UNDERWATER AT SEA. Journal Du Conseil, Vol. XXVI, No. 1, pp. 80-93.

Equipment for studying tuna behaviour underwater on the high seas is described. Starting with a ladder and diver, the staff of the Honolulu Biological Laboratory has progressed to a shielded ladder, an overside caisson, stern and bow blister, and underwater television. Future plans involve a small, fast submarine. The principal faults and virtues of each device are noted. (Auth. summ.)

4221. Klomp, H. 1961. THE CONCEPTS "SIMILAR ECOLOGY" AND "COMPETITION" IN ANIMAL ECOLOGY. Archives Neerlandaises de Zoologie, XIV, 1, 1961, pp. 90-102.

The process of competition is discussed in connection with its different meanings in biological literature.

The formulations "identical ecological requirements", "similar ecology" and others are discussed. It is concluded that neither is satisfactory, and that the circumscription of Birch (1957), holding that two or more animals compete when they use a common resource in short supply, should be preferred.

In this formulation the animals always utilize a common resource of the environment in the concrete sense of the word, as food, or nesting sites, the supply of which is short. In fact, in these cases the numbers of the animals are limited (or regulated) by the quantity of the resource. The animals compete, so to say, for the limited number of "places" present in the habitat. In other cases, however, the total number of available places may be determined by a common predator or parasite. Therefore, it is proposed to bring all cases under the same heading by saying that the animals compete when their numbers are limited by the same mechanism of

natural control.

In general the result of the competition process will be elimination of one or more of the sorts of animals involved, due to natural selection.

Under the definition of competition advocated in this paper most cases of stable polymorphism represent processes of intraspecific competition resulting in co-existence.

Mechanisms of co-existence in interspecific competitive processes are discussed. (Auth. summ.)

4222. Moody, Harold L. 1961. EXPLOITED FISH POPULATIONS OF THE ST. JOHNS RIVER, FLORIDA. The Quarterly Journal of the Florida Academy of Sciences, Vol. 24, No. 1, 18 pgs.

Records of more than 10 million pounds of fishes captured in large haul seines operated in the St. Johns River from mid-1948 through early 1953 were summarized by machine methods and analyzed. Data from nearly nine million pounds of fishes taken in approximately 4,000 net hauls made in Lake George yielded information regarding 44 available species. A total weight of more than six million pounds of all fishes except largemouth bass and chain pickerel was removed from Lake George by commercial crews who operated the nets. This amounted to an average monthly harvest of less than five pounds per acre. Netting and removal had no perceptible effect on the catch through the period of operations.

Angling pressure and catch were sampled in Lakes George, Crescent, and adjoining regions of the St. Johns River system by a statistically valid boat census during certain months of 1952-1953, and in 1956. Sportfishing pressure was found to be low. An average of less than one pound of sportfishes was estimated to have been caught per acre per month.

4223. Nielsen, E. S., and V. K. Hansen. 1959. LIGHT ADAPTATION IN MARINE PHYTOPLANKTON POPULATIONS AND ITS INTERRELATION WITH TEMPERATURE. Physiol. Plant., 1959, 12, 353-370; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 426. 1961.

Graphs showing the relation between light intensity and photosynthesis in marine phytoplankton are given; they represent plankton from both the surface and the lower part of the photosynthetic layer, arctic, temperate and tropical plankton, and summer and winter plankton. A typical light adaptation of phytoplankton according to depth is found only if the water masses within the photosynthetic layer are stabilized to prevent vertical mixing. There is a differentiation between sun and shade plankton; in sun plankton the rate of light-saturated photosynthesis per unit of chlorophyll is high while in shade plankton it is low. The light adaptation appears to be caused by establishing a higher or lower concentration of the enzymes active in photosynthesis. The rate of photosynthesis appears to be fairly independent of temperature in natural populations; the effect of a low temperature is counteracted by an increase in the concentration of enzymes.

4224. Herbst, H. V. 1958. QUANTITATIVE ZOOPLANKTON INVESTIGATIONS IN THE OLIGOTROPHIC EIFEL LAKES. Limnol. Schr Reihe, 1958, 5, No. 22, 27-47; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 427. 1961.

The author describes quantitative investigations into the zooplankton of two oligotrophic Eifel lakes, the Weinfelder of Toten Maar and the Pulvermaar, and compares the results with those obtained in the eutrophic Grosse Ploner lake. Seasonal variations in the distribution of plankton and the influence of light, temperature, currents, oxygen content, and nutrient supply are discussed.

4225. Berg, A. 1960. DETERMINATION OF CONDITIONS UNSUITABLE FOR THE GROWTH OF THE WATER HYACINTH, EICHHORNIA CRASSIPES (MART.) SOLMS, IN CERTAIN RIVERS OF THE CONGO BASIN. Bull. Centre belge Et. Document. Eaux, 1960, No. 47, 28-42; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 429. 1961.

Extensive surveys were made of the physicochemical characteristics of parts of the river Congo and its tributaries, and the results were compared with the populations of water hyacinth. The results, which are given in tables and graphs and discussed, show that the principal factor affecting the development of water hyacinth was the pH value; the minimum pH value permitting growth was, in general about 4.2, which corresponds in the humic brown waters of these tributaries to a maximum colour of 220° Hazen, a maximum oxygen demand of 22-23 mg. per litre, and a maximum acidity equivalent to 0.90 ml of normal sodium carbonate per litre. In waters with a pH value near this limit, water hyacinth could possibly grow if conditions were always shady, especially if the water was not continually so acid. On the basis of these results it should be possible to predict the geographical limits of growth of water hyacinth.

4226. Cushing, D. H. 1959. ON THE NATURE OF PRODUCTION IN THE SEA. Fish Invest., Lond., Ser. II, 1959, 22, No. 6, 44 pp; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 431. 1961.

The author discusses factors affecting the productivity of sea water. In order to explore theoretical possibilities he has assumed that grazing is the dominant factor in restricting algal reproduction and that lack of nutrients stops production only in the absence of grazers. For a model of production combining both effects the relation between algal reproductive rate and nutrient concentration must be more clearly established, and the exact mechanism of grazing determined.

4227. O'Connor, D. J. 1960. OXYGEN BALANCE OF AN ESTUARY. Proc. Amer. Soc. civ. Engrs, 1960, 86, SA3, 35-55, Pap. No. 2472; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 455. 1961.

The net seaward movement of organic impurities in estuaries is the result of displacement by the land run-off and the longitudinal diffusion of the tidal action. The dissolved oxygen profile depends on the concentra-

tion of the organic material, its rate of oxidation, and the resulting rate of re-aeration. A differential equation has been developed to express the interrelationship between these geophysical and biochemical factors under a steady state condition. The assumption of constant coefficients in the equation has been confirmed by the field data obtained from surveys of the Delaware and James river estuaries. Dissolved oxygen profiles calculated from the equation were found to give reasonably good agreement with the measured dissolved oxygen concentrations.

4228. Jenkins, J. E., C. E. Moak, and D. A. Okun. 1960. SEDIMENTATION IN RESERVOIRS IN THE SOUTHEAST. Proc. Amer. Soc. civ. engrs, 1960, 86 SA4, 55-70, Pap. No. 2557; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 477.

The most recent reservoir sediment data have been analyzed to evaluate factors that can be used to predict sedimentation in reservoirs in southeastern U.S.A. Such factors include rate and amount of rainfall and run-off, slope of the watershed, land use on the catchment area, and character of soil on the watershed. It was found that in this part of the country the annual volume of sediment is directly proportional to the drainage area, amounting to about 0.44 acre-ft per sq. mile.

4229. Stall, J. B., and Bartelli, L. J. 1959. CORRELATION OF RESERVOIR SEDIMENTATION AND WATERSHED FACTORS, SPRINGFIELD PLAIN, ILLINOIS. Ill. St. Wat. Surv. Div., Rep. Invest. No. 37, 1959, 22 pp; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 479. 1961.

From observations on 20 lakes of different size the relations between lake sedimentation data and watershed factors are discussed. All the lakes had watersheds in the deep loess soils of the Springfield Plain area in west-central Illinois, and it is stressed that the conclusions reached apply to this area only. The principal factors affecting silting are the slope of third-order streams, age, gross erosion, ratio of capacity to inflow, non-incised channel density, and shape of the watershed.

4230. Wood, E. M. 1960. DEFINITIVE DIAGNOSIS OF FISH MORTALITIES. J. Wat. Pollut. Contr. Fed., 1960, 32, 994-999; Water Pollution Abstracts, Vol. 34, No. 3, Abst. No. 563. 1961.

The author recommends the use of pathology procedures in conjunction with biological studies and bio-assays to determine the cause of fish mortalities.

4231. Kemp, P.S.J.T. 1958. TROUT IN SOUTHERN RHODESIA. V. ON THE TOXICITY OF COPPER SULPHATE TO TROUT. Rhod. agric. J., 1958, 55, 637-640; Water Pollution Abstracts, Vol. 34, No. 4, Abst. No. 564. 1961.

The use of copper sulphate to control the snails which act as the intermediate hosts of schistosomes has tended to increase recently, and it was decided to determine the possible effects of copper sulphate on trout in Southern Rhodesia. It was found that in the very soft waters which are typical of Rhodesian trout streams a concentration of 3 p.p.m. copper sulphate was toxic to trout. As concentrations as low as this are ineffective against molluscs and cercariae, the use of copper sulphate in trout streams does not appear to be justified. A concentration of 1 p.p.m. copper sulphate is sufficient to kill algae on which some fish and fish-food organisms live.

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